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KOMMISSIONEN FOR DANMARKS FISKERI- OG HAVUNDERSØGELSER

SERIE: FISKERI · BIND IX

NR. 1. ERIK M. POULSEN: BIOLOGICAL INVESTIGATIONS UPON THE COD IN DANISH WATERS

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI A/S
1931

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SERIE: FISKERI

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MEDDELELSER FRA KOMMISSIONEN
FOR DANMARKS FISKERI- OG HAVUNDERSØGELSER
SERIE: FISKERI · BIND IX · Nr. 1 · 1931

BIOLOGICAL INVESTIGATIONS UPON THE COD IN DANISH WATERS

BY

ERIK M. POULSEN

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI A/S
1931

I. Introduction.

The cod (*Gadus callarias L.*) is found in quantities in all the Danish waters and is of great importance practically everywhere for our fishery. It has, naturally enough, for many years been the subject of investigations on the part of Danish scientists. Henrik Krøyer (1843—1845) discusses the cod in great detail in his work on the fish in Danish waters. In Zoologia danica (G. Winther, H. I. Hansen and Ad. S. Jensen, 1878—1907) the cod, and especially its morphology, is subjected to a fairly close study. C. G. Joh. Petersen wrote a report in 1902 on some observations of the occurrence of fry and the adult cod in our waters. A. Otterstrøm (1906) carried these investigations further, insofar as they dealt with the fry, and for the first time gave a complete account of the occurrence of the fry in our waters. J. P. Jacobsen and A. C. Johansen (1908) have given a survey of the distribution and frequency of the larvae in 1907 and 1908 and investigated the conditions for the transport of cod eggs and larvae in our waters. P. L. Kramp (1913 and 1924) gave an account of the distribution of cod eggs in the southern Belt Sea and the Western Baltic in 1909 and 1922. H. Blegvad (1916) has dealt with the food of the cod and has given a brief report on the fluctuations in the frequency of different age groups in "Dansk Fiskeritidende" 1926. A. C. Strubberg (1922) treated their migrations.

Also German and Swedish scientists have investigated the stock of cod in the Danish waters, including the western and southern Baltic. The occurrence and distribution of cod eggs have been treated by Ehrenbaum and Strodtmann (1904), Strodtmann (1906 and 1918), Apstein 1911 and Heinen 1912. Chr. Hessle (1923) has investigated the growth of the cod in the Baltic proper.

Even though in the course of years various works have appeared dealing with cod, there are still important parts of the cod's biology which have either not been investigated at all or have only been the subject of rather limited investigations. Thus the occurrence and distribution of the different age groups of cod have not been treated in literature since Petersen dealt with them in 1902, that is, not since we have learnt to determine age by means of scales and otoliths, and the very important question of growth and different rate of growth in different waters has not been discussed. There have been no investigations on the fluctuations in the frequency of the fry from year to year.

Not only is it desirable to investigate those parts of the cod's biology which have remained unexamined, but a renewed investigation of the biological questions which had already been dealt with before 1913 may also be said to be necessary, since various circumstances tend to show that the conditions for the thriving and occurrence of the cod in our inner waters have altered to some extent in the last 10—15 years. In the first place there has been a very pronounced rise in the yield of the cod fisheries in the waters within the Skaw in the years subsequent to 1919. In the second place an unusually strong influx of salt water into our inner waters has frequently occurred in recent years (in 1923, 1925, and 1928, especially in 1923 and 1928); A. C. Johansen (1926) and Erik M. Poulsen (1928) have shown that such an influx can produce changes in the stock of fish. The current namely brought large numbers of haddock larvae into our waters both in 1923 and 1928, and there is reason to suppose that the same currents which brought in haddock fry also brought in numbers of cod fry. Thirdly, the stock of fish in the Belt Sea and the Western Baltic has in recent years undergone considerable changes owing to the great decrease in the numbers of plaice; the yield of the plaice fishery in these waters is now only between a half and a third of what it was in the years 1910—1914 (A. C. Johansen 1928). Such a great

decrease in the plaice stock can with some reason be regarded as an important factor in the food conditions for the other bottom fish, e. g. the cod.

In consideration of the above-mentioned circumstances, it must be regarded as of real interest to have the previous investigations continued, carried further, and supplemented with an investigation of the very important questions in the biology of the cod which have not hitherto been the subject of examination.

It has seemed to me most suitable to undertake a comprehensive investigation of the biology of the cod in the inner Danish waters.

I have been greatly encouraged to undertake such an investigation by the existence of a large and valuable material, of which for the most part practically no use has been made, and which has been collected in the course of the last 25 years by Kommissionen for Danmarks Fiskeri- og Havundersøgelser and by Dansk Biologisk Station.

Since A. Otterstrøm's investigations (1906) only a small portion of the material relating to cod, collected by the Danish Biological Station, has been utilized; in the course of time the annual investigations in Danish waters have produced a very considerable material. The most valuable part has been obtained in recent years (since 1921), during which the efforts of the Station have not been concentrated to such a degree as in the years 1909—1920 on carrying out valuations of the sea bottom. This material was obtained partly by fishing with the Tog during the years 1921—1929 (age analyses and measurements of cod) and partly by fishing with ring trawl (investigations on the frequency and occurrence of cod larvae) and Hensen Net (investigations on the numbers of eggs) in 1927, 1928, and 1929.

Kommissionen for Danmarks Fiskeri og Havundersøgelser collected in 1923—1926 with ring trawl and Petersen's young fish trawl an extremely valuable material for the purpose of throwing light on the occurrence and frequency of cod larvae, whilst at the same time quantitative investigations on the numbers of eggs were carried out with the Hensen Net. We possess in addition somewhat less comprehensive material of this kind collected in certain years before 1914. By trawling from the "Thor" before the war and from the "Dana" after it a fairly large material has been collected of cod which have been measured and also in many cases subjected to age analyses. Part of this material — from 1903 till 1907 — has been already dealt with (although the results have not been published) by A. C. Strubberg, who has kindly placed his calculations and charts at my disposal.

Finally I have made use of a number of stomach analyses and some racial analyses, which from time to time have been made either on board the Research Vessels or in the Laboratory from material purchased from fishermen.

I am greatly indebted to the Director of the Danish Biological Station, Dr. A. C. Johansen, for the readiness with which he has placed material at my disposal. I also wish to express my thanks to Mr. A. C. Strubberg, M. sc., for having so kindly presented me with some of the results of his investigations on the frequency of the cod, based on the trawlings carried out from the "Thor" in 1903—1907. Finally my thanks are also due to the following gentlemen who have been of great assistance to me in producing the material for the investigation: Mr. K. Buus, Mr. Cloos Lorentzen, Mr. P. F. Erichsen, Mr. J. Jensen, Mr. I. M. Jensen, Mr. Vilh. Kristiansen, Mr. L. P. Poulsen, Mr. Trolle Thomsen.

II. The Distribution of the Cod in the Waters around Denmark.

The cod is a boreal fish. In the Atlantic Ocean it is found from the west coast of Greenland (as far north as 70° N. Lat., Ad. S. Jensen 1925, p. 20) to Cape Hatteras on the east coast of North America (35° N. Lat.), and from Spitzbergen and Novaya Zemlya to the Bay of Biscay. In the Pacific Ocean it is found as far south as the coasts of Japan and Oregon. It is also found in the seas adjoining the

North Atlantic Ocean, e, g. in the Davis Strait, the Barents Sea, the North Sea, the Danish seas, and the Baltic.

The cod penetrates a fairly long distance into the brackish Baltic. As far north as off Västernorrlands Len in Sweden a quite considerable cod fishery is still carried on, and cod are distributed throughout the whole of that part of the Gulf of Bothnia which lies between the Åland Islands and Kvarken (64° N. Lat.). In the more northern part of the Gulf of Bothnia to the north of Kvarken it is only a rare visitor, and it is not found at all in the northernmost part between the Uleå and Luleå. At Kvarken the salinity (according to R. Witting 1912, p. 24) at 0 m. is 5.0 per mille, at 50 m. 5.6 per mille, and at the bottom (100 m.) 5.7 per mille.

The cod also occurs in the Gulf of Finland but only in the western part is it to be found in numbers (I. Alb. Sandman 1906, p. 165). On the other hand a fairly considerable cod fishery is carried on off the coasts of Latvia and in the Gulf of Riga.

The cod's vertical distribution extends from 0 m. to c. 500 m. It occurs in the very shallow water along the coasts, on a zostera bottom as well as on a sandy bottom; it is common on the harder stony bottom farther out and on a mud bottom. It is rarely found on an ooze bottom at a depth of more than 300 m., and by the Danish investigations in Skagerak it is not found at greater depths than c. 450 m.

A general impression of the occurrence and frequency of the cod within the Danish seas may be obtained by considering the different fishery yields in the different Danish waters such as are published in the Fiskeri-Beretning. In 1927 the following quantities of cod were caught in the different waters:

North Sea	3.5	million	kg.	Belt Sea	7.6	million	kg.
Skagerak	2.2	—	-	Western Baltic	0.5	—	-
Kattegat	6.1	—	-	Baltic proper	1.2	—	-
Sound	1.5	—	-	Limfjord	0.07	—	-

A few years ago the cod fishery yield in the Limfjord was much larger (thus amounting in 1922 to 0.9 million kg.).

The largest cod fisheries in Danish waters are thus in the Kattegat and Belt Sea.

An investigation of the distribution and frequency of the cod in the different Danish waters can be made on the basis of the comprehensive material collected in the course of years by trawlings from the "Thor" and "Dana", and by fishing experiments with the tog carried out from the "Japetus Steenstrup".

From the "Thor" a series of trawlings was carried out, especially in the years 1903—1907, in practically all the Danish waters. From the "Dana" a number of trawlings were carried out in the years 1922—1927 in the different Danish waters, but not so many as in 1903—1907. Table 1 shows in a concise form the number of cod caught during these trawling experiments in the different years and in the different waters[1].

If we consider first of all the distribution within the different waters regardless of the depth, we see that in 1903—1907 the following number of cod were caught per hour of trawling:

In the North Sea	13.5	In the Belt Sea	0.8
- - Skagerak	4.2	- - Western Baltic	0.9
- - Kattegat	4.2	- - Baltic proper	1.2
- - Sound	1.5		

The cod was thus most common in the North Sea, less common in the Skagerak and Kattegat (4.2 per hour), whilst in the Belt Sea, the Western Baltic, and the Baltic proper only c. 1 cod was caught per hour of trawling.

[1] The same type and size of trawl — a 50 feet otter trawl — was used both on the "Thor" and the "Dana".

Table 1. Catch of Cod with Ottertrawl from "Thor" in the years 1903—1907 and from "Dana" in the years 1922—1927.

Year	1903—1907				1922—1927			
Area	Number of Stations	Number of trawl-hours	Number of cod	Number of cod per trawl-hour	Number of Stations	Number of trawl-hours	Number of cod	Number of cod per trawl-hour
North Sea:								
0—20 m	51	142	3506	24.7	29	20 3/4	126	6.1
20—40 -	48	95	151	1.6	40	38	336	8.8
40—60 -	23	58 1/2	343	5.9	9	12	35	2.9
60—80 -	1	1	0	0	..	..	..	..
> 200 -	1	1	2	2.0	..	..	..	..
Total...	124	297 1/2	4002	**13.5**	78	70 3/4	497	**7.0**
Skagerak:								
0— 20 m	28	97	572	5.9	14	13 1/2	22	1.6
20— 40 -	10	22	133	6.0	4	2 1/6	26	1.2
40— 60 -	5	6 1/3	46	7.3	..	..	..	..
60— 80 -	8	33	163	4.9	..	..	..	..
80—100 -	4	6	23	3.8	1	2	4	2.0
100—200 -	14	33	38	1.2	1	1	4	4.0
> 200 -	17	42 1/2	30	0.7	4	6	10	1.7
Total...	86	239 5/6	1005	**4.2**	24	24 2/3	66	**2.7**
Kattegat:								
0— 20 m	79	184	434	2.4	14	9 3/4	78	8.0
20— 40 -	76	283	1468	5.2	5	5	132	26.4
40— 60 -	10	26	171	6.6	1	2	14	7.0
60— 80 -	4	6 1/2	16	2.5	..	..	..	..
80—100 -	1	1	4	4.0	..	..	..	..
Total...	170	500 1/2	2093	**4.2**	20	16 3/4	224	**13.4**
The Sound	5	5 1/2	8	**1.5**	..	..	..	..
Belt Sea	8	13	11	**0.8**	7	9 1/2	180	**18.9**
Western Baltic	3	3 1/2	3	**0.9**	3	3	36	**12.0**
Baltic proper:								
0— 20 m	13	25 1/2	32	1.3	3	1 5/6	9	4.9
20— 40 -	5	5	6	1.2	5	4 1/4	30	7.1
40— 60 -	1	1 1/2	1	0.7	6	5 1/2	68	12.4
60— 80 -	1	1	1	1.0	4	4 3/4	361	76.0
80—100 -	1	1/2	0	0.0	2	1	89	89.0
Total...	21	33 1/2	40	**1.2**	20	17 1/3	557	**32.1**
All waters together	417	1093 1/3	7162	**6.6**	152	142	1560	**11.0**

If we on the other hand consider the years 1923 till 1927, we find that distribution is quite different, the following number of cod being caught per hour of trawling:

In the North Sea	7.0	In the Belt Sea	18.9
- - Skagerak	2.7	- - Western Baltic	12.0
- - Kattegat	13.4	- - Baltic proper	32.1

There is thus a very marked difference between the distribution in the two periods, (of which more will be said in a later section) but the observations show that the cod is common throughout all our waters from the North Sea and far into the Baltic.

It also occurs in most of our fjords. As a rule it is common in the Limfjord, a considerable cod fishery having been carried on there for many successive years. During a period of hard frost in February 1923 most of the Limfjord's cod stock disappeared; large numbers were observed drifting dead on the surface after the ice had broken up. At fishing experiments in the following years only extremely few

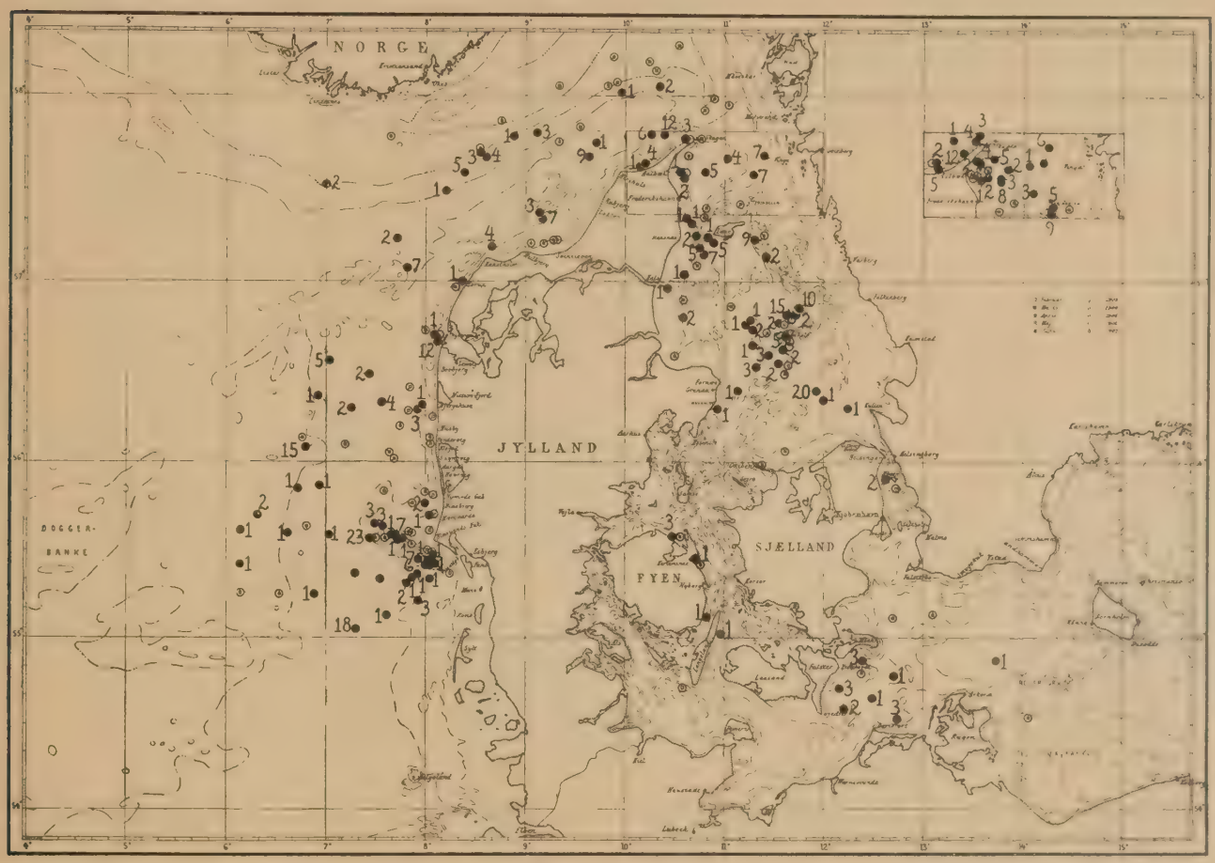

Fig. 1 a. Number of cod caught per trawl-hour in the Danish waters in the first half of the year in the period 1903—1907.

cod were observed in the Limfjord. Not until the summer of 1928 did a number of cod (of the 0-Group) reappear in the Limfjord. In Ringkøbing Fjord and Nissum Fjord only very few cod are caught, and none were found at the fishing experiments with fine-meshed otter trawl which were carried out in the years after the war in Ringkøbing Fjord. The cause of this was probably the low salinity, (this varies between 4 and 10 per mille in the greater part of the Fjord, but at times owing to a more copious discharge of fresh water from the Skernaa and the Vondaa it can fall to still lower values). In the salt-water period, when the Hvide-Sande Canal was open, the cod was common in the Fjord (see A. C. JOHANSEN 1913), 8,590 kg. of cod being thus caught in 1912. In the brackish-water period from about 1845 till 1910, the cod was an infrequent visitor to the Fjord. In the Nymindestrøm itself (the saltest part of the Fjord) it was however fairly common in the autumn.

There is fishing for cod throughout the whole of the Isefjord with Holbæk Fjord, Lammefjord, and the

outer parts of Roskilde Fjord. In 1928, cod of the I-Gr. and 0-Gr. were caught from the "Japetus Steenstrup« at 4 stations throughout the Isefjord both in the inner and outer broads. No older cod than the I-Gr. were taken at these fishing experiments, but the yield of the commercial fishery shows that there are also older and larger cod in the Fjord. Of the 0-Gr. an extraordinarily large number were taken at the fishing experiments in 1928, far more than at any other place in our waters.

In Randers Fjord (A. C. Johansen and J. Chr. Løfting, 1919, p. 24) cod are not always present; they only penetrate at times — especially in the autumn — into the outermost part of the Fjord. In the

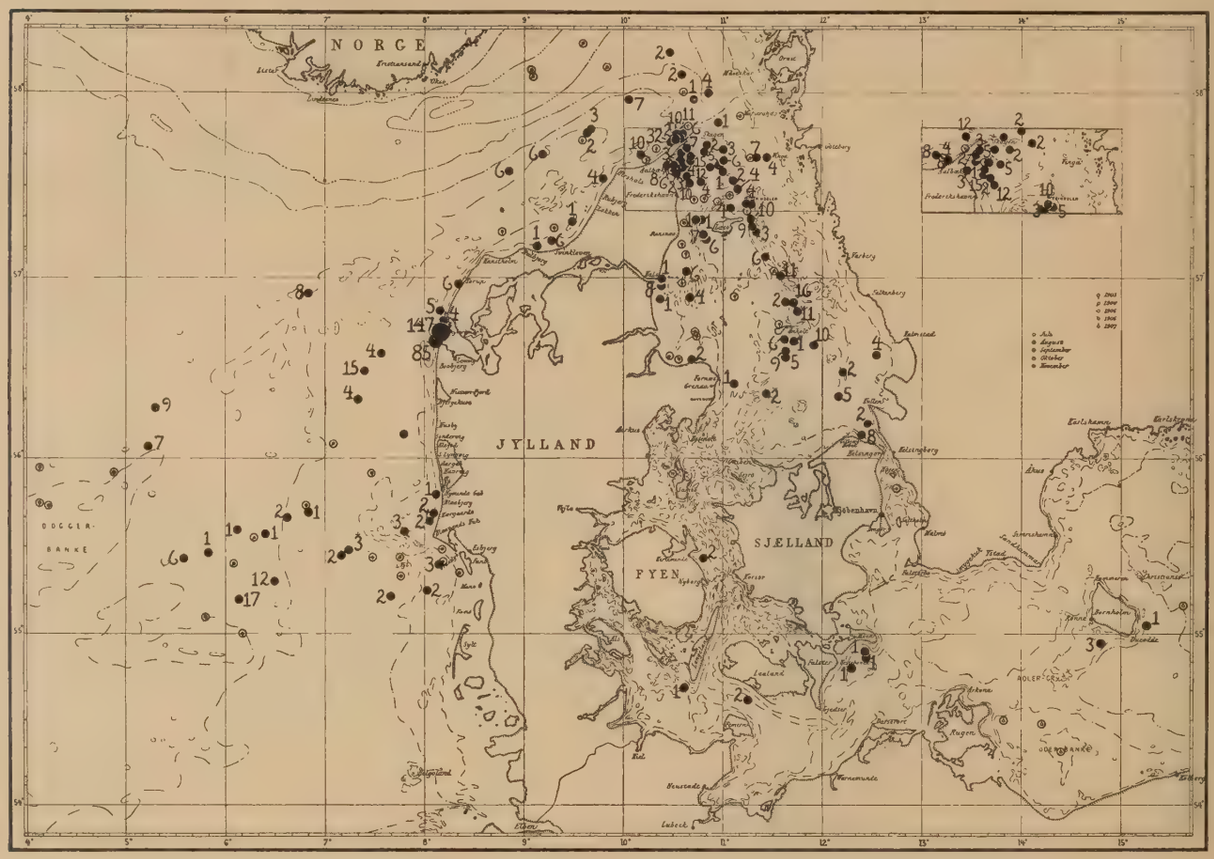

Fig. 1 b. Number of cod caught per trawl-hour in the Danish waters in the last half of the year in the period 1903—1907.

outer part of the Fjord the mean salinity at the bottom is about 17—24 per mille. It is therefore not due to a low salinity that the cod are not always present in Randers Fjord. The difficulty of access to the Fjord is more likely to be the cause, there being only a narrow channel in the entrance of more than 2 metres' depth; also in the Fjord itself the water of more than 2 metres' depth is limited to a small channel, and cod do not in general occur in water of less depth than 2 metres.

In our more open fjords, as for instance, Horsens Fjord, Vejle Fjord, Kolding Fjord, and Aabenraa Fjord cod are caught throughout their entire areas. A fairly large number are caught in the outer portion of Odense Fjord, but in the inner portions on the other hand the cod are very few. In the outer part of the narrow Haderslev Fjord there is fishing for cod, but not in the innermost part.

A concise picture of the cod's distribution in relation to the depth can be obtained, by considering the results of the trawling experiments carried out from the "Thor" and the "Dana".

An investigation of the cod's distribution — both regional and vertical — is rendered somewhat difficult by the fact that the cod is to some extent a shoal fish. On the charts (Fig. 1—4) which show the presence of cod at the stations, taken in the course of years by the "Thor" and "Dana", and in 1927 and 1928 by the "Japetus Steenstrup", it will be noticed that widely differing numbers are frequently caught on the same day at two adjacent stations. Thus on one day in 1927, S. S. E. of Hals, 246 cod

Fig. 2. Number of cod caught per trawl-hour in the Danish waters from "Dana" in the years 1922—1926.

were caught at one station and only 10 at another which was only about 1 nautical mile distant, the tog being used in each case and the depths being the same. In Kerteminde Bay in May 1927, 86 cod were caught at one station on the same day that only 1 was caught at an adjacent station, the depths being the same. In 1927 to the west of Bornholm, 63 cod were taken at a station of 44 metres' depth, but not more than 3 at a station of 49 metres' depth only 7 nautical miles distant[1]. In looking at the charts of the fishing experiments we are apt at the first glance to get an impression of a certain lack of

[1] It is also seen during commercial fishing operations that the cod is a shoal fish. It is thus a common occurrence that the fishermen take an extraordinarily large number of cod in one haul of their Danish seines and otter seines, but obtain very few in the next haul at practically the same spot.

conformity to natural laws in the cod's distribution. In order to diminish the disturbing influence brought about by the fact that cod often keep together in shoals, I have taken together the stations of about the same depth within the same area. Table 2 gives thus a concise presentment of the cod's varying numbers

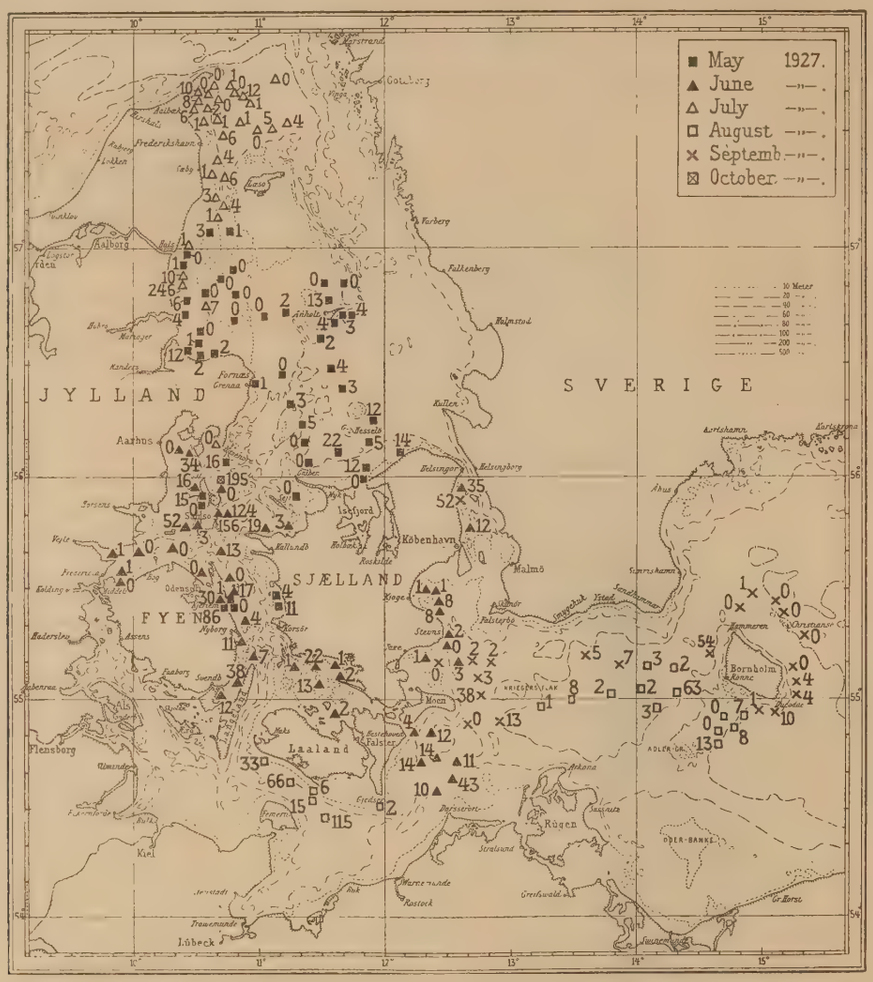

Fig. 3. Number of cod caught per 30 minutes with tog in the Danish waters in 1927.

Table 2. Average Number of Cod caught per Trawl-hour in different Depth-areas in the North Sea, Skagerak, Kattegat and Baltic proper in the years 1903—1907 & 1922—1927.

Depth-area	North Sea		Skagerak		Kattegat		Baltic proper	
	1903—07	1922—27	1903—07	1922—26	1903—07	1922—26	1903—07	1922—26
0— 20 m	24.7	6.1	5.9	1.6	2.4	8.0	1.3	4.9
20— 40	1.6	8.8	6.0	1.2	5.2	26.4	1.2	7.1
40— 60	5.9	2.9	7.3	..	6.6	7.0	0.7	12.4
60— 80	0	..	4.9	..	2.5	..	1.0	76.0
80—100	..	..	3.8	2.0	4.0	..	0	89.0
100—200	..	..	1.2	(4.0)	..	..	..	..
200—400	2.0	..	0.8	(2.3)	..	..	..	..
> 400	..	..	0	(0.5)	..	..	..	..

in the different depth zones in the North Sea, Skagerak, Kattegat, and the Baltic on the basis of the material shown in Table 1. In the North Sea the cod is most commonly found in depths of less than 60 metres. It is less numerous in the deeper parts of the North Sea out towards the Skagerak.

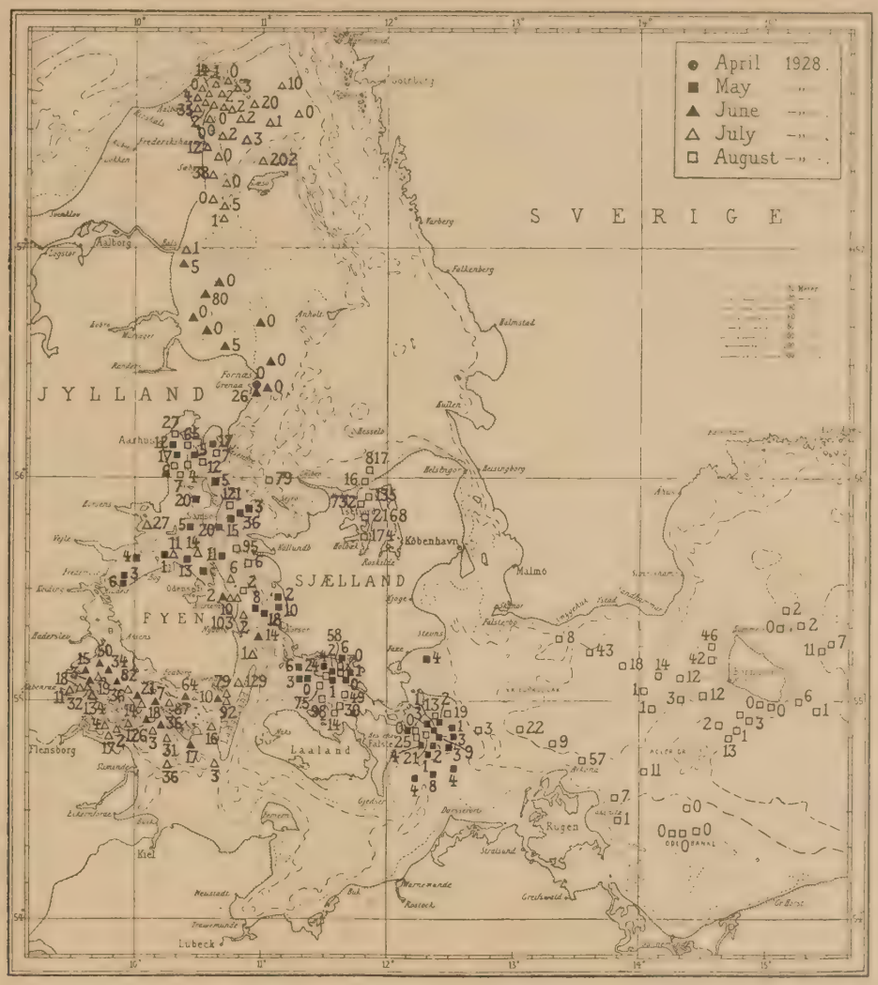

Fig. 4. Number of cod caught per 30 minutes with tog in the Danish waters in 1928.

It is also common in the Skagerak at depths up to c. 60—80 metres. Even at depths between 80 and 100 metres it is captured fairly frequently in the trawl. From the deeper parts of the Skagerak the material collected in 1922—1926 is very slight, trawling experiments having been carried out here for only 7 hours in all during this period. In 1903—1907 on the other hand, fishing experiments were carried out (see Table 1) for nearly 80 hours. The tables of the catches in 1903—1907 show a very marked decrease in numbers as the depth increases. Even between 100 and 200 metres the cod were scarce, and at depths between 200 and 400 metres only a few were caught; at depths exceeding 400 (400—600) not a single cod was caught in 17½ trawling hours; in the period 1922—1926 however 1 cod was caught at the depth of 450 metres. It is only the larger and older cod which enter the deeper water; of 18 cod caught in the Skagerak at depths of more than 200 metres, one was 44 cm. in length, 3 between 50 and 60 cm., and the remaining 14 between 60 and 90 cm. In the Kattegat the cod is most

frequently met with at intermediate depths between 20 and 60 metres, and is caught rather less often in the quite shallow water along the coast and in the deep channel in the north-eastern Kattegat. When we consider the results of fishing operations carried out with the tog from the "Japetus Steenstrup" in the

Table 3. Number of Cod of different Age-groups caught per $^1/_2$ hour with Tog from „Japetus Steenstrup" in various Depth-areas in Kattegat in May and July 1927, June-July 1928 and July-Sept. 1929.

	m	No. of hauls	No. of minutes fished	Age-groups							No. of individuals
				0	I	II	III	IV	V	VI	
May 1927	3—10	14	530	..	0.2	1.0	..	0.1	..	..	22
	11—20	18	555	..	0.4	2.4	0.3	0.8	0.1	0.1	76
	21—30	11	281	..	0.1	3.8	0.3	0.7	0.1	0.1	48
No. of individuals	..	..	..	..	12	97	9	23	2	3	146
July 1927	3—10	11	188	12.7	0.6	0.6	..	..	..	..	87
	11—20	7	210	..	0.4	3	..	..	..	..	24
	21—30	8	215	..	0.4	1.5	0.3	..	..	..	17
	31—40	1	30	..	..	..	..	..	..	..	..
	41—50	3	90	0.3	0.7	1.3	0.7	..	..	..	8
No. of individuals	..	..	..	80	12	40	4	..	..	..	136
June—July 1928	3—10	13	264	24.6	7.8	0.3	0.1	..	..	..	291
	11—20	10	320	0.2	0.5	..	..	..	..	..	7
	21—30	8	240	2.5	1.5	..	..	..	..	..	33
	31—40	1	30	1	2	..	..	..	..	..	3
	41—50	3	90	3	3	..	..	..	..	..	11
No. of individuals	..	..	..	252	89	3	1	..	..	..	345
July—August—Sept. 1929	3—10	17	380	24.7	15.2	1.4	..	0.1	..	..	472
	11—20	16	400	21.5	4.5	0.2	..	0.4	0.1	0.4	301
	21—30	21	590	2.2	5.1	1.3	0.1	0.5	..	..	98
	31—40	13	375	..	4.3	1.0	..	0.2	0.1	0.1	65
No. of individuals	..	..	..	559	303	52	1	15	2	4	936

Kattegat in 1927, 1928, and 1929, (Table 3) we obtain an apparently quite different picture of the distribution of numbers in relation to the depth, since the fine-meshed tog takes chiefly the smaller fish (0-Gr. and I-Gr.), whereby the shallow water, where these age groups are specially to be found, gives the appearance of being comparatively abundant in cod. If we however consider the catches for May (in which month the 0-Gr. does not occur in the catches) we see that the greatest catches are obtained outside the 10 metre line.

In the Baltic round Bornholm the cod descends to the greatest depths (c. 100 metres). As a rule it occurs here most frequently in the lower, relatively salt water layers from c. 40 to 100 metres' depth. At the fishing experiments with otter trawl carried out from the "Dana" in June 1923, the cod were most numerous at depths between 60 and 100 metres. At fishing experiments with the tog carried out from the "Japetus Steenstrup" round Bornholm in 1927 and 1928 the bulk of the cod were found at 60—80 metres' depth.

The cod thus occurs so to say everywhere in our waters. There are only few in the deeper parts

of the Skagerak, but otherwise they are found everywhere, both along the coasts and out in the more open waters. They make their way into bays, coves, fjords, and sounds, and the youngest year class in particular can occur in extremely large numbers in the more closed inlets, such as for instance the Isefjord.

III. Are there different Races of Cod in our Waters?

KRØYER (1843—1845) speaks of different subspecies of cod which are distinguished the one from the other by a difference in colour, as for instance the "grey cod" from a mud bottom and the "red cod" from a seaweed bottom. WINTHER (1879) observed that there are different local varieties of cod. PETERSEN (1902) has however shown that the differences in colour according to which the cod were hitherto divided into subspecies and varieties are not in reality racial characters, but can change with their surroundings; he put namely a number of "red cod" on a grey bottom and in the course of a week they had become "grey cod". On the basis of a series of fishing experiments for large cod and larvae, PETERSEN (p. 14) was of the opinion that he could establish the fact that "part of our cod immigrate [from the North Sea as small and grow up in our seas, while others half-grown as well as large ones immigrate yearly, and none or next to none live through their whole life in our seas". He writes that from this "it is a logical consequence that the cod in our seas must on the main be looked upon as a small part of the North Sea cod-tribe, which does not exist independently. — Not only does this become a necessary consequence but all our cod must be brothers and sisters; it must be impossible to point out different races of them in our seas". Even the Baltic, in PETERSEN's opinion, contains the same race of cod as the Kattegat and the North Sea. As he namely found no cod fry when carrying on investigations in 1901 in the waters around Bornholm, he assumed that the larvae of the cod could not possibly thrive in the Baltic and that all the cod which were found in no small quantities right up as far as Finland had immigrated through the Danish waters either as small or medium fish. In order to study the racial question more exactly he counted the fin rays of 76 cod from Store Belt and 25 from Esbjerg. The results of this were "so exactly alike that I very soon gave up finding any difference in race on that point". However he did not calculate the mean of the rays in the different fins but merely established the fact that the number of rays in each of the dorsal and anal fins varied within the same limits in the case of the cod from Esbjerg and those from Store Belt. A calculation based on his data relating to mean numbers shows however some difference in the average number of rays:

	Store Belt	North Sea
1. Dorsal fin	13.6	14.2
2. — -	18.4	18.6
3. — -	17.7	18.3
1. Anal fin	19.6	19.0
2. — -	16.9	17.2

These numbers being as they are, the possibility of a racial difference cannot be disregarded, but the material is much too small to base any definite theory on it.

In recent years the racial question has been reopened, and JOHS. SCHMIDT gives in the Rapports et Procès-Verbaux, Vol. LIV (1929) a brief preliminary resumé of the results of investigations in recent years; as regards the racial differences among the cod in Danish waters he writes as follows: "The cod populations living in the Baltic differ from other European cod populations not only in biological characters such as the spawning season but also in morphological respects. The best character as far known is the average number of rays in the second dorsal fin which in the Baltic cod is below 18. Values varying from 17.24 to 17.98 were found in the 11 samples examined being distributed from all parts of the Baltic east

of Bornholm including the Gulf of Bothnia and Gulf of Finland. In the western part of the Baltic (west of Bornholm) and in the Belt Sea and Cattegat the average value was found to exceed 18 increasing again to more than 19 in the North Sea and Norwegian Sea".

As the racial question has been thus taken up on a broad basis from another quarter I will confine myself in the following to a short description of the racial investigations which are carried out on occasions by the Danish Biological Station and the Home Fishery Section of the Danish Commission for the Exploration of the Sea.

The vertebrae have been counted in 811 individuals; the mean numbers for the separate samples are given in the table below:

Locality	Date	Mean No. of Vertebrae			No. of Indiv.	Age Group	Investigator
		Prae-caudal	Caudal	Total			
North Sea & Skagerak	1905	18.35	33.73	52.10	109	..	A. C. Johansen
North Kattegat	1905	18.35	33.74	52.09	54	..	—
Aalborg Bay	1905	18.23	33.65	51.88	26	..	—
— -	1916	18.41	33.16	51.57	106	..	—
Als Fjord	25/7 1928	18.23	33.48	51.71	130	I	S. W. Fogh, Erik M. Poulsen
Isefjord	1/8 1929	18.52	33.13	51.65	89	I	Erik M. Poulsen
—	23/10 1929	18.47	33.23	51.69	118	0	—
—	—	18.62	33.12	51.74	68	I	—
North Sea off Thyborøn	31/10 1929	18.32	33.53	51.85	111	I	—

The vertebral column is obtained by boiling the cod and then removing the soft parts; when it has dried the vertebrae stand out distinctly and can easily be counted, even in the case of comparatively small individuals (0-Gr.). It happens in an isolated case or two that the head comes off, but nevertheless it is possible to make sure that the first vertebra has not come off with the head since it has a very characteristic shape, its neural spine being broader than those of the other vertebrae and somewhat bent forward at the point, possessing also two projections pointing anteriorly. As the last vertebra is reckoned the one which lies behind the last raised junction of vertebrae in the vertebral column, possible rudimentary vertebrae behind this thus not being reckoned in. The vertebra reckoned as the last is shown in Fig. 5. The number of praecaudal vertebrae is defined as the number of vertebrae in front of the first vertebra with a completely closed haemal arch.

The rays in the 2nd dorsal fin of 1267 individuals have been counted; the mean numbers for the separate samples are given in the table below:

Locality	Date	Mean No. of rays	No. of Indiv.	Age Group	Investigator
Aalborg Bay	1905	18.37	27	..	A. C. Johansen
North Sea off Thyborøn	31/10 1929	18.91	111	I	Erik M. Poulsen
Off Frederikshavn	10/5 1929	18.34	253	I-VII	—
Limfjord	10/9 1929	18.17	100	I	—
Kerteminde Bay	2/5 1929	18.41	98	II-VII	—
Smaalandshavet	11/1 1929	18.38	60	I-VII	—
Aabenraa Fjord	9/5 1929	18.61	101	II-V	—
Adler Grund	31/1 1929	17.46	90	I-V	—
Rønne Bank	12/5 1929	17.53	80	II-VI	—
Isefjord	1/8 1929	18.07	235	I	—
—	23/10 1929	17.73	162	0	—
—	—	18.24	70	I	—

No difficulties present themselves in counting the rays in the 2nd dorsal fin; the first ray is always well developed and easily recognizable, not being as for instance in the case of herring at times almost completely hidden in the flesh.

We possess no records of counting of the vertebrae of the cod from the Baltic, but only from the Belt Sea, Kattegat, and North Sea. The analyses which have been made show only a slight variation in the mean number of vertebrae for these waters. The numbers vary from 51.57 to 52.10, the highest being found in the North Sea and the northern part of the Kattegat.

An examination of the caudal and praecaudal vertebrae alone shows no difference of any importance between the stocks in these 3 areas.

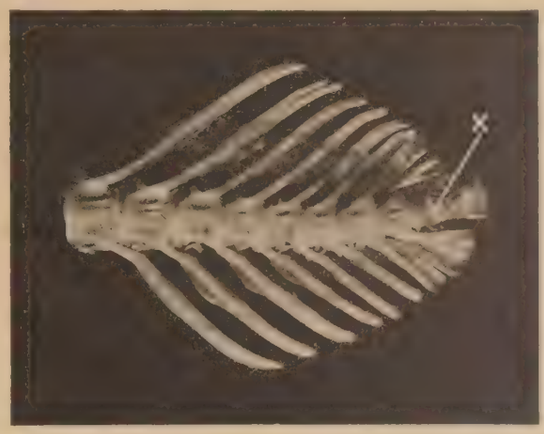

Fig. 5. Posterior part of the vertebral column of a cod. The white arrow indicates the vertebra counted as the last.

Johs. Schmidt (1929) has observed that the numbers of rays decrease towards the south, and he connects this phenomenon with the increasing temperature, but other factors, e. g. the decrease of depth and the shorter distance from land are mentioned as tending to reduce the number of vertebrae. As we pass in from the North Sea through the Danish waters the temperature decreases and we should therefore find a rise in the mean number of vertebrae, but at the same time the depth and the distance from land decrease wherefore we should find a decrease in the mean number. It is a fact that we cannot show that there is a regular increase or decrease in the number of vertebrae as we pass through our waters.

We possess analyses of the numbers of rays in the 2nd dorsal fin of cod from the waters around Bornholm, through the Belt Sea and Kattegat and out into the North Sea. Here we find, in agreement with Johs. Schmidt's observations, an appreciable decrease in the numbers of rays from the North Sea and into the Baltic.

In the North Sea (off Thyborøn) the mean number of the rays in the 2nd dorsal fin is 18.91, in the Kattegat and Belt Sea it varies from 17.73 to 18.61, and in the waters around Bornholm (Adler Grund, Rønne Bank) it is 17.46 and 17.53. The difference between the number of rays for the North Sea and for the Baltic is so great that we are justified in assuming that there are different races of cod, viz. a North Sea race and a Baltic race.

In the Belt Sea and Kattegat we find a mean number which lies between the mean numbers for the North Sea and the Baltic. These intermediate values can be due either to the existence of separate races in our inner waters or to an intermingling of the two races. This question will be discussed in the following section dealing with the migrations of cod.

IV. The Migrations of Cod.

It is well known that cod undertake migrations of considerable extent. Johan Hjort (1914, p. 104 et seq.) has pointed out the very extensive migrations of cod in the sea along the west and north coasts of Norway. Many observations have also been made in Danish waters which tend to show that cod here undertake migrations of greater or less extent. C. G. Joh. Petersen (1902, p. 12) mentions thus that in summer a migration occurs from shallow to deep water and in autumn again to some extent a migration back to the shallow water. But the cod also cover greater distances in their migrations, of which

PETERSEN writes (1902, p. 13) that without doubt great numbers of medium and very large cod enter our inner waters every year from the North Sea. This immigration begins at the same time as the immigration of the fry (i. e. in late summer), but it appears to be especially active in mid-winter. PETERSEN bases this theory on the fact that far fewer cod are caught in fishing operations in the Kattegat in the summer than in the winter. As this proof for migration is of an indirect nature and is by no means decisive, it was only natural that attempts should be made to produce some more direct proof of migrations by the means of marking experiments. During the years 1905—1913 therefore, a series of marking experiments were carried out on cod in the Danish waters by Dr. A. C. JOHANSEN. The results were elaborated and published by A. C. STRUBBERG (1922). In all, 1550 individuals were marked during these years. Apart from the fact that these experiments produced important results as regards growth and the intensity of fishing, they also contributed in some measure to the solution of the question of the cod's migrations. A. C. STRUBBERG writes (p. 47) with reference to this part of the results: "In a few isolated cases individuals have covered great distances, ... A particularly long migration is shown to have been made by a cod, 37 cm. in length, which in 1905 was marked off Thyborøn and $2^1/_2$ months later was recaptured down by the entrance into the English Channel, a distance of at least 330 miles traversed in less than 74 days. Shorter migrations, although still of fairly great length, were undertaken by a few individuals, very large for the most part, which starting from the south-western Kattegat in the course of one or a few months penetrated far into the Sound or through Store Belt down past Langeland. A few individuals marked in the southern Skagerak and the northernmost part of the Kattegat passed round the Skaw from the Skagerak to the Kattegat and vice versa; a few crossed the Skagerak and made their way as far as the coast of Sweden, but none of these migrations exceeded comparatively few nautical miles. Thus on the whole, it has only been established in quite a few cases that migrations have taken place from one area to another, at all events within the period and the size groups our experiments were concerned with."

Thus a direct proof is here brought forward that the cod undertake migrations in and out of our waters. The experiments have not however — as the author points out — been sufficiently comprehensive to show at what seasons and to how great an extent these migrations take place.

In order to understand how the cod stock in our inner waters is maintained — whether merely by the growing up of the fry produced therein or also largely by the immigrations of cod both old and young from outside — it is of great importance to form some idea as to the extent of the immigrations and as to which age groups in particular are immigrating.

In the above-mentioned racial analyses we have a means of estimating the extent of the immigrations and which age groups are concerned.[1]

If we consider the figures given on p. 14, we see that the lowest values for the fin rays in the 2nd dorsal fin occur in the Baltic around Bornholm, whilst the analyses from the North Sea show the highest value; in the intervening waters are found values which lie between these two extremes. This may be due, as mentioned in the preceding section, either to the presence in these intervening waters of cod races possessing less rays than the North Sea cod and more than the Baltic cod or to the presence in these waters of a cod stock originating from an intermingling of the two races. A closer investigation of the racial characters may show to what extent the one or the other of these two explanations is correct.

Table 4 shows the mean number of rays in the 2nd dorsal fin and of vertebrae of the different year classes.

If we consider the number of rays it will be seen that in most cases it increases from the younger to the older age groups. Thus in the sample from Aabenraa, the mean number of rays in the II-Gr. is 18.32, in the IV-Gr. 18.70, and in the V-Gr. 18.78. There is thus a striking difference between the II-Gr. and the IV-Gr. In the Adler Grund sample there is an equally pronounced increase from the II-Gr.

[1] The question of the immigration of larvae will be dealt with in a later section.

Table 4. Racial Investigations of Cod from the Waters round Denmark.
A. Number of Rays in 2nd Dorsal Fin.

Locality and Date	No. of Rays	Age Group 0	I	II	III	IV	V	VI	VII	Total
North Sea, 10 miles NW. of Thyborøn 31. Oct. 1929	16	..	1	..	..	..	..	..	..	1
	17	..	9	..	..	..	..	..	..	9
	18	..	32	..	..	..	..	..	..	32
	19	..	40	..	..	..	..	..	..	40
	20	..	17	..	..	..	..	..	..	17
	21	..	10	..	..	..	..	..	..	10
	22	..	2	..	..	..	..	..	..	2
	No. of sp.	..	111	..	..	..	..	..	..	111
	Mean	..	**18.91**	..	..	..	..	..	..	**18.91**
	σ	..	1.17	..	..	..	..	..	..	1.17
	σm	..	0.11	..	..	..	..	..	..	0.11
Off Frederikshavn 10. May 1929	16	..	..	15	1	2	1	..	1	20
	17	..	1	29	7	9	..	1	..	47
	18	..	1	68	4	5	4	1	..	83
	19	..	2	38	3	5	..	1	1	50
	20	..	..	31	3	5	..	..	..	39
	21	..	..	10	..	..	..	..	..	10
	22	..	1	3	..	..	..	..	..	4
	No. of sp.	..	5	194	18	26	5	3	2	253
	Mean	..	**19.00**	**18.43**	**18.00**	**18.08**	**17.60**	**18.00**	**17.50**	**18.34**
	σ	..	..	1.35	1.24	1.29	..	..	..	1.35
	σm	..	..	0.10	0.29	0.25	..	..	..	0.09
The Limfjord Livø Broad 10. Sept. 1929	15	..	1	..	..	..	..	..	..	1
	16	..	7	..	..	..	..	..	..	7
	17	..	24	..	..	..	..	..	..	24
	18	..	34	..	..	..	..	..	..	34
	19	..	20	..	..	..	..	..	..	20
	20	..	7	..	..	..	..	..	..	7
	21	..	4	..	..	..	..	..	..	4
	22	..	3	..	..	..	..	..	..	3
	No. of sp.	..	100	..	..	..	..	..	..	100
	Mean	..	**18.17**	..	..	..	..	..	..	**18.17**
	σ	..	1.39	..	..	..	..	..	..	1.39
	σm	..	0.14	..	..	..	..	..	..	0.14
Isefjord 1. Aug. 1929	14	..	1	..	..	..	..	..	..	1
	15	..	3	..	..	..	..	..	..	3
	16	..	15	..	..	..	..	..	..	15
	17	..	54	..	..	..	..	..	..	54
	18	..	84	..	..	..	..	..	..	84
	19	..	51	..	..	..	..	..	..	51
	20	..	19	..	..	..	..	..	..	19
	21	..	8	..	..	..	..	..	..	8
	No. of sp.	..	235	..	..	..	..	..	..	235
	Mean	..	**18.07**	..	..	..	..	..	..	**18.07**
	σ	..	1.23	..	..	..	..	..	..	1.23
	σm	..	0.08	..	..	..	..	..	..	0.08
Isefjord 23. Oct. 1929	14	..	1	..	..	..	..	..	..	1
	15	3	1	..	..	..	..	..	..	4
	16	18	1	..	..	..	..	..	..	19
	17	50	18	..	..	..	..	..	..	68
	18	49	23	..	..	..	..	..	..	72
	19	34	12	..	..	..	..	..	..	46
	20	7	10	..	..	..	..	..	..	17
	21	1	4	..	..	..	..	..	..	5
	No. of sp.	162	70	..	..	..	..	..	..	232
	Mean	**17.73**	**18.24**	..	..	..	..	..	..	**17.88**
	σ	1.14	1.38	..	..	..	..	..	..	1.24
	σm	0.09	0.16	..	..	..	..	..	..	0.08

Table 4 (continued).

Locality and Date	No. of Rays	Age Group								Total
		0	I	II	III	IV	V	VI	VII	
Kerteminde Bay	16	..	..	2	..	1	1	..	..	4
	17	..	..	9	1	11	1	1	..	23
2. May 1929	18	..	..	10	2	10	1	..	..	23
	19	..	..	8	5	11	2	2	1	29
	20	..	..	6	..	7	2	..	..	15
	21	..	..	2	..	2	..	..	..	4
	No. of sp.	..	..	37	8	42	7	3	1	98
	Mean	..	..	**18.35**	**18.50**	**18.43**	**18.43**	**18.33**	**19.00**	**18.41**
	σ	..	..	1.32	0.76	1.25	1.51	..	..	1.23
	σm	..	..	0.22	0.27	0.19	0.57	..	..	0.12
Smaalandshavet	14	..	..	..	1	..	..	..	..	1
	15	..	..	..	..	..	..	..	..	..
11. Jan. 1929	16	..	1	1	3	..	..	..	..	5
	17	..	..	..	7	..	..	..	..	7
	18	..	..	1	14	..	..	..	..	15
	19	..	..	3	15	2	..	..	1	21
	20	..	1	1	8	..	..	..	..	10
	21	..	..	..	1	..	..	..	..	1
	No. of sp.	..	2	6	49	2	..	..	1	60
	Mean	..	**18.00**	**18.50**	**18.35**	**19.00**	..	..	**19.00**	**18.38**
	σ	..	..	..	1.33	..	..	..	..	1.33
	σm	..	..	..	0.19	..	..	..	..	0.17
Aabenraa Fjord	16	..	..	1	1	4	..	..	..	6
	17	..	..	3	..	12	1	..	..	16
9. May 1929	18	..	..	9	1	16	4	..	..	30
	19	..	..	6	..	14	2	..	..	22
	20	..	..	3	..	12	1	..	..	16
	21	..	..	..	1	7	..	..	..	8
	22	..	..	..	..	2	1	..	..	3
	No. of sp.	..	..	22	3	67	9	..	..	101
	Mean	..	..	**18.32**	**18.33**	**18.70**	**18.78**	..	..	**18.61**
	σ	..	..	1.04	..	1.52	1.48	..	..	1.44
	σm	..	..	0.22	..	0.19	0.49	..	..	0.14
Adler Grund	15	..	..	2	2	..	..	..	..	4
Bornholm	16	..	..	10	5	2	..	..	..	17
	17	..	..	14	14	1	1	..	..	30
31. Jan. 1929	18	..	1	7	5	6	1	..	..	20
	19	..	1	5	6	2	..	..	..	14
	20	..	..	1	3	..	..	..	..	4
	21	..	..	..	..	..	..	..	..	..
	22	..	..	..	..	..	..	..	..	..
	23	..	..	..	..	1	..	..	..	1
	No. of sp.	..	2	39	35	12	2	..	..	90
	Mean	..	**18.50**	**17.15**	**17.49**	**18.17**	**17.50**	..	..	**17.46**
	σ	..	..	1.18	1.34	1.80	..	..	..	1.31
	σm	..	..	0.19	0.23	0.52	..	..	..	0.14
Rønne Bank	14	..	..	..	..	1	..	..	..	1
Bornholm	15	..	..	..	..	..	..	..	..	..
	16	..	..	2	6	7	..	..	..	15
12. May 1929	17	..	..	1	2	18	2	1	..	24
	18	..	..	3	4	13	3	..	..	23
	19	..	..	1	3	8	2	1	..	15
	20	..	..	..	..	1	..	..	..	1
	21	..	..	..	1	..	..	..	..	1
	No. of sp.	..	..	7	16	48	7	2	..	80
	Mean	..	..	**17.43**	**17.50**	**17.46**	**18.00**	**18.00**	..	**17.53**
	σ	..	..	1.14	1.50	1.13	0.82	..	..	1.18
	σm	..	..	0.43	0.12	0.16	0.31	..	..	0.13

Table 4 (continued). **B. Number of Vertebrae.**

Locality	North Sea and Skagerak	10 miles NW of Thyborøn	North Kattegat	12 miles SE of Hals	Aalborg Bay Kattegat	Isefjord	Isefjord	Isefjord	Als Fjord
Date	1905	$^{31}/_{10}$ 1929	1905	$^{31}/_{3}$-$^{6}/_{4}$1905	$^{23}/_{5}$ 1916	$^{1}/_{8}$ 1929	$^{23}/_{10}$ 1929	$^{23}/_{10}$ 1929	$^{25}/_{7}$ 1928
Age Group		I			I (II)	I	0	I	I
Vert. praecaudal.									
16	..	..	..	..	1	..	..	..	2
17	1	1	1	..	4	4	5	..	7
18	69	73	34	20	52	36	53	26	81
19	39	37	18	6	49	48	60	42	39
20	..	..	1	..	..	1	..	..	1
No. of spec.	109	111	54	26	106	89	118	68	130
Mean	**18.35**	**18.32**	**18.35**	**18.23**	**18.41**	**18.52**	**18.47**	**18.62**	**18.23**
σ	0.50	0.49	0.55	0.43	0.61	0.61	0.58	0.49	0.63
σm	0.05	0.05	0.08	0.08	0.06	0.06	0.05	0.06	0.06
Vert. caudal.									
30	..	..	..	..	..	1	1	..	..
31	..	1	1	..	4	1	4	5	2
32	4	8	..	1	19	17	19	10	9
33	32	39	19	8	44	40	47	31	52
34	62	54	26	16	34	25	38	16	60
35	11	7	8	1	5	4	8	6	6
36	..	..	..	..	..	..	1	..	1
No. of spec.	109	109	54	26	106	88	118	68	130
Mean	**33.73**	**33.53**	**33.74**	**33.65**	**33.16**	**33.13**	**33.23**	**33.12**	**33.48**
σ	0.69	0.76	0.78	0.63	0.91	0.89	1.00	1.02	0.79
σm	0.07	0.07	0.11	0.12	0.09	0.10	0.09	0.12	0.07
Vert. Total.									
49	..	1	1	..	2	2	2	2	2
50	..	4	..	1	11	5	11	7	6
51	15	25	10	6	31	30	39	12	38
52	68	59	27	14	50	32	40	34	66
53	26	20	14	5	11	13	22	12	18
54	..	..	2	..	1	2	4	1	..
No. of spec.	109	109	54	26	106	84	118	68	130
Mean	**52.10**	**51.85**	**52.09**	**51.88**	**51.57**	**51.65**	**51.69**	**51.74**	**51.71**
σ	0.61	0.79	0.87	0.77	0.92	0.98	1.04	1.02	0.82
σm	0.06	0.08	0.12	0.15	0.10	0.11	0.10	0.12	0.07

through the III-Gr. to the IV-Gr. In the sample from the waters S. of Arnager the increase is not very marked but the tendency is perceptible. In the sample from Smaalandshavet the increase is not pronounced, but this was not to be expected since only one group — the III-Gr. — is represented at all abundantly. There is also no increase in the sample from Frederikshavn. The increase in the Isefjord sample is particularly evident. On October 23rd 1929, the 0-Gr. had a mean number as low as 17.73, whilst that of the I-Gr. was 18.24, having been only 18.07 two or three months previously. Here there is thus a distinct increase in the mean number of rays from the 0-Gr. to the I-Gr., and within one and the same I-Gr. there is an increase, although less pronounced, from August 1st till October 23rd. The analyses of the number of rays thus show, in respect to the Baltic, the Belt Sea, and the Isefjord a distinct increase in the mean number of rays in the 2nd dorsal fin from the 0-Gr. up to the older age groups. If we take together the 2 samples from the waters S. of Bornholm, we obtain the following mean numbers for the different age groups (in the sample taken in January the age groups are stated as if the fish were caught after April 1st):

Age Group	II	III	IV	V	VI
Mean No. of rays	17.67	17.26	17.47	18.11	17.75
No. of individuals	9	55	83	19	4

The samples from the Isefjord, Aabenraa Fjord, Kerteminde Bay, and Smaalandshavet taken together give the following result: (in the sample taken i January the age groups are stated as if the fish were caught after April 1st).

Age Group	0	I	II	III	IV	V	VI	VII	VIII
Mean No. of rays	17.73	18.11	18.33	18.47	18.52	18.67	18.33	19.00	19.00
No. of individuals	162	305	61	17	158	18	3	1	1

By taking these samples together, the increase in the mean number of rays from the youngest to the older age groups becomes plainly apparent.

This increase shows clearly that cod from the northernmost part of the Kattegat, the Skagerak, and North Sea immigrate into the Belt Sea, Baltic, and the southern Kattegat (Isefjord). That this immigration is on a considerable scale may be seen from the fact that the number of rays increases appreciably. If we assume that the 0-Gr. at Bornholm possesses c. 17.00 rays, which is certainly not far wrong, whilst the IV-Gr. possesses 17.50 this means that between the 0-Gr. and the IV-Gr. an immigration has taken place amounting to c. $^1/_3$ of the original stock, since we can assume that the mean number of rays of the immigrating cod is 18.50. Assuming that the 0-Gr. in the southern Kattegat and Belt Sea has 17.75 rays (see the Isefjord sample) and the IV-Gr. 18.50 (see samples from the commercial fishery), and that the corresponding cod from outside have 19.00 (see the sample from Thyborøn) the calculated immigration, for the Belt Sea and Kattegat areas, will amount to 60 per cent. of the original stock. These figures show, even though of course they must be used with some caution, that immigration takes place on a considerable scale, an immigration which is so great as to play an important part in the renewal of the stock in these waters. In order to determine more closely and accurately the importance of this immigration for the renewal of the cod stock in the Baltic and Belt Sea, it will be necessary to continue the racial analyses, such as those mentioned here, so as to extend over several years and comprise both the quite young individuals of the 0-Gr. and I-Gr. and also the older age groups.

In addition to the immigration discussed above, larvae are also brought into the Belt Sea and Baltic with the southgoing under-current; we cannot on the basis of the investigations carried out hitherto form any really accurate conception of the size and importance of this immigration, which will be discussed more closely in the section dealing with the yearly fluctuations in the number of larvae.

With regard to the racial question and the migrations of the cod in the Belt Sea and Baltic, C. G. Joh. Petersen writes (1902, p. 14) that the cod in our waters must as a whole be looked upon as a small part of the North Sea cod stock with no independent existence; as to the cod stock in the Baltic he writes "that all the cod which in considerable multitudes, are fished as far north as Finland, have immigrated in these parts through the Danish seas as small or middle-sized fish". A. Otterstrøm (1906) holds the same opinion. On the other hand J. P. Jacobsen and A. C. Johansen (1908, p. 23) write: "It is beyond doubt that the Kattegat, the Belt Sea, and the true Baltic have their own indigenous stock ot cod, besides the stock immigrating from the Skagerak in the winter months". Johs. Schmidt (1929) writes: "Our investigation thus shows that the cod populations of the Baltic are indigenous". On the basis of the present investigations the actual facts with regard to the maintenance of the Baltic cod stock — at all events in the Bornholm waters — would appear to be that the Baltic has its own indigenous

cod stock, but that in addition a fairly considerable immigration takes place into the Baltic from outside. There is also an indigenous stock in the Kattegat and Belt Sea, but also here a considerable immigration takes place, an immigration which doubtlessly is not confined to the winter months; analyses of the I-Gr. from the Isefjord tend to show that it occurs also in the late summer and in the autumn.

V. The Propagation and Development of Cod.

1. Spawning.

In the Danish waters the cod spawn in the winter and spring months; in the Baltic proper around Bornholm the spawning continues until well into summer. Henrik Krøyer wrote (1843—1845): "The cod begin to spawn in January, and this continues well into March or perhaps even longer." G. Winther (1875) wrote that the cod spawn in Great Belt in April. In Zoologia Danica (G. Winther, H. I. Hansen, and Ad. S. Jensen 1878—1907), it is stated that the time of spawning varies considerably but that it always occurs towards the end of winter or in the beginning of spring. Off the south coast of Skaane the cod spawn in April and May. The fluctuations in the time of spawning are considered to be connected with the temperature of the sea-water.

C. G. Joh. Petersen (1902) found that of the cod caught on hooks in Great Belt on March 29th and 31st 1900 "the largest cod from the deep water were spawning, nearly all the males being full of ripe milt, and some of the females of ripe spawn. Not so, however, the smaller ones under 14 inches (36.5 cm.) in length" (p. 4). At the beginning of April he found cod in full spawn around Fænø in Little Belt. He wrote moreover that the cod spawn i February, March, and April, but he does not enter into the question of different spawning seasons in different waters.

P. L. Kramp (1913) dealt with the egg collections which had been made with the Hensen net in Langelands Belt between April 10th and June 27th, 1909 and, with reference to the spawning in this area, he wrote: "The maximum falls late in April, the eggs being somewhat less common in the middle of the month. Just after the time of the maximal occurrence the number decreases suddenly, some few eggs being found during the month of May, none in June."

In March 1922 egg collections were made in the southern part of the Belt Sea and in the Western Baltic from the Fishery Patrol Steamer "Falken", the first collection being made on March 14—15th, and the second on March 27—29th. Kramp (1924) found that in the interval between the two collections "the average number of eggs of all stations taken together increased from 71 to 114 per sq. metre of surface. This indicates that the maximal spawning took place at a time nearer by the date of the second than by that of the first cruise."

Detailed investigations on the spawning season for cod in the Western Baltic and Baltic proper have been carried out by German scientists (Ehrenbaum & Strodtmann 1904, Strodtmann 1906 and 1918, Apstein 1911, Heinen 1912, Hensen 1919, and Mielck 1926).

Ehrenbaum & Strodtmann (1904) found that in 1903 spawning culminated in March in the Western Baltic, and in April in the Bornholm Deep. Strodtmann (1906) found that in 1904 and 1905 spawning was practically over in the beginning of May in the Western Baltic. In the Bornholm Deep on the other hand Strodtmann found that there was a considerable amount of spawning taking place in August, and he also showed that a number of eggs which had been found in the Bornholm Deep at the investigations in August 1903 were cod eggs, whereas they had previously been determined as "pleuronectes ähnliche". He sums up his results in these words "Wir haben also in der östlichen Ostsee beim Dorsch eine ähnliche in der Länge gezogene Laichzeit wie bei der Scholle."

Apstein (1911) found that in 1909 spawning culminated in April in the western portion of the Western Baltic (W. of Femern Belt), but not until the end of April and the beginning of May in the eastern portion. In the Bornholm Deep he found eggs in May, June, and August.

Heinen (1912) wrote about the spawning in 1911 that it commenced at the beginning of January in the western portion of the Western Baltic and culminated in February. In March it was rather less active, and in the course of this and the following month the number of eggs decreased very greatly, a few eggs however being still found in June. In the eastern portion of the Western Baltic spawning commenced later and culminated in March. Only a very few eggs were found in April and May.

In the Baltic proper the results were very irregular and only showed that spawning here had lasted much longer than in the Western Baltic.

Strodtmann (1918) found that in 1906 spawning culminated at the end of March in the Western Baltic, and in May-June in the deeper parts of the Baltic proper.

Fig. 6. Number of cod-eggs caught per m^2 surface by bottom-surface hauls with Hensen Net in April, May and June 1923.

Mielck (1926) found in April 1925 cod eggs both in the Western Baltic and in the Bornholm Deep.

If we now summarize the results of these investigations we see that spawning does not take place at exactly the same time each year. In the southern portion of the Belt Sea the time when spawning culminates varies between the beginning of March and the beginning of April; in the Western Baltic it even varies between February and May, although in general spawning culminates at the end of March or in April. In the Baltic proper eggs have been found in the months February—August.

To supplement the above-mentioned investigations, the results of the Danish investigations of eggs in the southern Kattegat, the Belt Sea, the Western Baltic, and the Baltic proper, carried out in the years 1923—1929, will be discussed in the following.

The collections were made with a Hensen Net of Müller gauze No. 3 and a diameter at the mouth of 67 cm., the area of the mouth being thus $^1/_8$ sq. metre. At each station 1 haul (in a number of cases 2 or 3 hauls) was generally made from the bottom to the surface. On occasions hauls were also made from a depth of 10 metres to the surface. On the charts, Figs. 6—14, the number of eggs found at the different stations in hauls from the bottom to the surface, calculated per sq. metre of surface, are given for each year.

Only in a few cases has there been any difficulty in determining to what species the eggs belong. The eggs containing an oil-globule (Onos, Trigla, turbot), eggs with a reticulated egg membrane (Clupea sprattus), and eggs with a large perivitelline space (long rough dab) are first sorted out. There then remain, as far as the waters are concerned in which the investigations have been made (the southernmost Kattegat, Belt Sea, Western Baltic, and Baltic proper),[1] the eggs of cod, plaice, flounders, dabs, and perhaps in a very few cases whiting. Plaice eggs are so distinct in appearance and size from cod eggs that there is no danger of their being confused. The cod eggs can be distinguished from the remainder of these eggs by measuring the diameters. The measurements of the eggs are done, as they lie in water in a watch-glass, with aid of an ocular micrometer. All the eggs found in the samples are measured.[2] In most cases the egg is measured along two diameters at right angles to each other, the mean of the two diameters being then taken as the result. Cod eggs are practically spherical, the two diameters differing only very slightly, as is shown by a number of measurements given below of cod eggs from one and the same station (the measurement is given in units of micrometer scale):

86—86	86—88	87—89	88—89	88—89	89—90
90—92	91—92	92—93	94—97	95—95	95—95
95—99	96—97	96—97	96—96	96—96	98—98
98—98	98—99	98—97	98—98	98—98	98—99
98—99	99—100	98—100	100—100	101—98	
100—101	102—105	103—103	103—104	104—105	

Fig. 7. Number of cod-eggs caught per m² surface by bottom-surface hauls with Hensen Net in April 1924.

In order to show to what an extent cod eggs can be distinguished from the eggs of flounder and dab, all the eggs of these 3 species from the Hensen net catches in 1927 are tabulated in Table 5. A sign by one of the black dots signifies that the egg represented by this dot contained a fully pigmented cod embryo. The eggs are sharply divided into two groups: firstly a group of small eggs (0.80 mm.—1.23 mm.). This group has two maxima, one around 0.87 mm. and another around 1.07 mm.; the smaller of these eggs must be ascribed to dabs and the larger to flounders. The spawning season of the dab occurs, according to A. C. JOHANSEN (1912), a little later than that of the flounders, and accordingly we find only the larger eggs — of flounders — as early as at the beginning of March, whilst we find both the larger and the smaller eggs — of flounders and dabs — at the beginning of April. The second group is numerous and consists of medium-sized eggs — of cod — in size from c. 1.30 to 1.62 mm. A number of these eggs contain embryos with fully developed pigment, which can be determined as cod, the smallest being 1.34 mm. and the largest 1.60 mm. The sizes of cod and flounder eggs possibly overlap slightly and it is not impossible that just a few flounder eggs have been counted as cod eggs and vice versa; but as this involves only a small fraction of the eggs it may be neglected when considering the conclusions which will be drawn from the material.

[1] As haddock eggs cannot always with certainty be distinguished from cod eggs, I have only included in my egg investigation the southernmost Kattegat and the waters to the south of it, since we can rely on there being no or only very few haddock eggs in these waters.

[2] The samples for the years 1923—1928 have been preserved in formalin while the samples from 1929 are preserved in 70 % alcohol.

Table 5. Diameter of Eggs of Cod, Flounder and Dab caught in hauls with Hens

	Diameter of egg in	units of micrometer-scale	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	7
		mm (calculated)	0.80	0.82	0.83	0.85	0.86	0.88	0.89	0.91	0.92	0.94	0.95	0.97	0.99	1.00	1.02	1.03	1.05	1.06	1.08	1.09	1.11	1.12	1.1
	Date	Locality	Depth, m																						
Belt Sea – South, Little Belt	1. III	NE of Vresen	25	..	..	..	..	..	..	..	..	..	..	..	..	●	..	..	..	..	..	..	..	..	..	..
	2. III	SSE of Romsø	24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	●	..	..	●	..	..	..	..
	,,	W of Asnæs	33	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	●	..	..	..	..	..	..	..
	,,	NNW of Refsnæs	43	..	..	..	..	..	..	..	..	..	..	..	●	..	..	..	..	..	●	..	..	..	..	..
	5. III	W of Samsø	35	..	..	..	..	..	..	..	..	..	..	..	..	..	..	●	●	●●	..	●	●●	●	..	..
	8. III	E of Hov	38	..	..	..	..	..	..	..	..	..	..	..	..	..	●	..	..	..	..	..	..	..	..	..
	9. III	S of Omø	12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	,,	S of Kirkegrund	16	..	..	..	..	..	..	..	●	..	●	..	..	●●	●	..	..	..	..	..	..	..	..	..
	,,	S of Glænø	13	..	..	..	..	..	..	..	..	..	..	..	..	..	●	..	..	..	..	..	..	..	..	..
	,,	W of Enø	12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	10. III	SE of Omø	13	..	..	..	..	..	..	..	..	..	●	..	..	..	..	●	●●	●	..	..	●	..	●	..
	,,	,,	15	..	..	..	..	..	..	..	..	..	..	..	..	●	●●	●	..	●	..	..	..	●	..	..
	,,	Omø Sound	38	..	..	..	..	..	..	●	..	..	..	..	..	●	..	..	..	..	●	..	..	..	..	..
		Total	..	..	..	..	..	..	..	1	1	..	2	1	1	4	7	5	3	5	2	1	3	2	1
Western Baltic	8. III	SW of Gulstav	17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Belt Sea – South, Little Belt	4. IV	W of Sprogø	23	..	..	..	..	..	●	●	..	..	..	..	..	..	..	●	..	..	..	..	..	..	..	●
	5. IV	SW of Asnæs	33	..	..	..	..	..	..	●	..	..	..	..	..	..	●●	●	..	..	●● ●	..	..	..	..	..
	6. IV	NW of Sejrø	44	●	..	..	●	..	●	●	●	●●	..	..	..	..	..	..	..	●●	●	..	..	●	..	..
	,,	NW of Refsnæs	43	..	●	●	●●●	●●	●●● ●	●●●	●	●	..	●	●	●●	●●	●●	..	..	..	●	..	..	..	..	..
	,,	W of Samsø	35	..	..	●	..	●●● ●	●●	●●	●●	●	..	..	●●● ●●●	●	●	●	●●●	●	●	●●	..	●	..	..
	7. IV	SW of Samsø	26	..	●●	●●	●	●●● ●●	●●● ●●● ●●●	●●● ●●●	●●● ● ●	●●● ● ●	●	●●	●●●	●●	..	●●	●●●	●	●	●	..	●	●	●●
	,,	NE of Æbelø	22	..	..	●	..	●●● ●●● ●	●●● ●●●	●●●	●●	●	●	●●●	●●	●	..	..	..	●●	..	..	..	..	●	●
	,,	WNW of Æbelø	17	..	●	●●	..	●●●	●	●●	●	..	●	..	..	..	..	..	●●	..	..	●●	●●	..	..	..
	10. IV	SE of Hov	21	..	..	..	..	..	..	..	..	..	●	..	..	●	..	●	●	●●	●●	●	..	●	..	..
		Total	1	4	7	5	21	24	19	11	10	4	6	12	7	3	8	11	8	5	10	2	4	2	4
Southern Little Belt	8. IV	S of Fænø	33	..	..	..	..	..	..	●	..	●	..	..	..	..	●	..	..	..	●	●	●	..	..	..
	,,	SE of Halk	26	..	..	..	..	..	..	..	..	..	..	●	..	..	..	..	..	..	..	..	..	..	..	..
	,,	W of Nordborg	30	..	..	..	..	..	●●	●	..	●●● ●	●●	●	..	..	..	●	..	●	..	..	..	..	..	..
	9. IV	W of Lyø	34	..	..	..	..	..	..	●	..	..	..	●	..	..	..	..	●●	..	●●	●●	●	..	●	..
	,,	SW of Skjoldnæs	34	..	..	..	..	..	..	●	..	●	..	..	●	..	..	●	●	..	●●	●●	●	●	..	..
		Total	..	..	..	..	..	..	2	4	..	6	2	3	1	..	1	2	3	1	5	5	3	1	1	..
Western Baltic	9. IV	SW of Ærø	34	..	..	..	..	..	..	●	..	..	●	..	..	..	..	..	..	..	..	..	●	..	..	..
	10. IV	W of Gulstav	21	..	..	..	..	..	..	..	●	●	..	..	..	..	..	..	..	..	●	..	..	..	..	..
	,,	ENE of Kjelsnor	19	..	..	..	..	..	●	..	●	..	..	..	..	..	..	..	..	..	..	●	..	..	..	..
		Total	..	..	..	..	..	..	1	1	2	1	1	..	..	..	..	..	..	..	1	1	1	..	..	..

from bottom to surface in March and April 1927 (one haul at each locality).

76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
1.17	1.19	1.20	1.22	1.23	1.25	1.26	1.28	1.29	1.31	1.32	1.34	1.36	1.37	1.39	1.40	1.42	1.43	1.45	1.46	1.48	1.49	1.51	1.52	1.54	1.56	1.57	1.59	1.60	1.62
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Fig. 8. Number of cod-eggs caught per m² surface by bottom-surface hauls with Hensen Net in April 1925.

A series of calculations of the mean sizes of cod eggs from the years 1923—24, and 1927 have given the following figures in millimetres. The number of eggs measured are given in brackets:

Belt Sea	April 1923 ...	1.36 (12)
Western Baltic	— — ...	1.45 (112)
Bornholm Deep	June — ...	1.50 (164)
Belt Sea	April 1924 ...	1.46 (433)
—	March 1927 ..	1.45 (173)
—	April — ..	1.42 (120)
Western Baltic	— — ..	1.45 (44)

The figures from 1923 show that the eggs in the Bornholm Deep are somewhat larger than those in the other waters; the mean size is however not as high as that given by EHRENBAUM. The two sets of measurements from the Belt Sea in 1927 show that the eggs are on an average larger in March than in April, which is in agreement with EHRENBAUM's statement that eggs are largest at the beginning of the spawning season.

In Table 6 will be found the number of eggs — calculated per sq. metre of surface — taken

The size of the cod eggs varies somewhat from area to area and from month to month. EHRENBAUM (1909) gives the following mean sizes in millimetres for cod eggs:

	Jan.	Feb.	March	April	May	Aug.
North Sea	1.46	1.45—1.46	1.41—1.39	1.30	..	..
Western Baltic	..	..	1.51	..	1.42	..
Bornholm Deep	..	..	..	..	1.76	1.64

The largest eggs are thus found at the commencement and the smallest at the end of the spawning season. The eggs in the Bornholm Deep are larger than those in the North Sea and the Western Baltic. STRODTMANN (1918) assumes that this increase in size of cod eggs in the Baltic proper is an adjustment to the lower salinity there. SCHNEIDER (1908) found the mean size for cod eggs from the Baltic to lie between 1.5 mm. and 1.7 mm., one egg however measuring only 1.3 mm. His material however only consisted of 20 eggs.

Fig. 9. Number of cod-eggs caught per m² surface by bottom-surface hauls with Hensen Net in April and May 1926.

Table 6. Number of Cod-Eggs caught per m² surface with Hensen Net by bottom-surface hauls in the southernmost part of Kattegat, the Sound, Belt Sea and Baltic in various months of the years 1923—1929.

		1923			1924			1925			1926			1927			1928			1929		
		No. of eggs	No. of hauls	No. of eggs per 1 m²	No. of eggs	No. of hauls	No of eggs per 1 m²	No. of eggs	No. of hauls	No. of eggs per 1 m²	No. of eggs	No. of hauls	No. of eggs per 1 m²	No. of eggs	No. of hauls	No. of eggs per 1 m²	No. of eggs	No. of hauls	No. of eggs per 1 m²	No. of eggs	No. of hauls	No. of eggs per 1 m²
Southernmost part of Kattegat + the northern part of the Sound	March	..	..	..	..	..	..	..	..	..	..	..	..	15	1	45.0	..	..	..	..	..	..
	April	1	1	3.0	42	3	42.0	17	9	5.7	5	4	3.8	..	..	..	..	..	..	10	34	0.9
	May	0	4	0	..	..	..	..	..	..	0	1	0	..	..	..	..	..	..	3	14	0.6
Belt Sea excl. the southern part of the Little Belt	March	..	..	..	..	..	..	..	..	..	..	..	..	197	16	36.9	..	..	..	..	..	..
	April	12	5	7.2	142	9	47.3	9	6	4.5	..	..	..	47	9	15.8	..	..	..	144	30	14.4
	May	0	8	0	..	..	..	..	..	..	4	5	2.4	..	..	..	..	..	..	13	76	0.5
	June	0	1	0	..	..	..	..	..	..	..	..	..	..	..	..	0	2	0	..	..	..
Southern part of the Little Belt	March	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	April	..	..	..	108	3	108	..	..	..	..	..	..	71	5	42.6	..	..	..	68	2	102.0
	May	..	..	..	..	..	..	..	..	..	4	3	4.0	..	..	..	..	..	..	2	24	0.3
	June	3	2	3	..	..	..	..	..	..	..	..	..	..	..	..	1	7	0.4	..	..	..
Western part of Western Baltic	March	..	..	..	..	..	..	..	..	..	..	..	..	13	1	39.0	..	..	..	..	..	..
	April	105	8	39.4	143	6	71.5	18	2	27.0	..	..	..	44	3	44.0	..	..	..	97	8	36.4
	May	..	..	..	..	..	..	..	..	..	1	3	1.0	..	..	..	..	..	..	3	20	0.5
	June	0	7	0	..	..	..	..	..	..	..	..	..	..	..	..	0	7	0	..	..	..
Eastern part of Western Baltic	April	17	3	17.0	..	..	..	1	3	1.0	..	..	..	..	..	..	..	..	..	..	..	..
	May	..	..	..	..	..	..	..	..	..	3	3	3.0	..	..	..	..	..	..	0	6	0
	June	5	2	7.5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Baltic proper E. of Sealand, Møen and Falster	April	6	2	9.0	..	..	..	0	4	0	..	..	..	..	..	..	..	..	..	..	..	..
	May	..	..	..	..	..	..	..	..	..	2	6	1.0	..	..	..	..	..	..	..	..	..
	June	7	13	1.6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Arkona Basin	April	..	..	..	..	..	..	0	1	0	..	..	..	..	..	..	..	..	..	..	..	..
	June	67	8	25.1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rønne Bank - Adler Gr.	June	10	6	5.0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bornholm-Deep	June	171	10	51.3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Oder Bank	June	5	1	15.0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

with the Hensen net in hauls from the bottom to the surface in different areas from the southern Kattegat through the Belt Sea into the Baltic.

In Table 7 are given in concise form the average numbers of cod eggs taken in different waters both at the investigations in the years 1923—1929 and at the investigations whose results were published earlier. It will be seen from Table 7 that in the Kattegat and in the Sound N. of Drogden the greatest number of eggs were taken in February and a slightly smaller number in March; in April the number was much smaller whilst in May it was negligible. No investigations have been made in January, but as such a large quantity of eggs were taken in February there is every reason to suppose that spawning occurs to no slight extent in January. In the Belt Sea (apart from the southern portion of Little Belt) the chief spawning season must be judged to occur in March, since by far the greatest number of eggs are taken in this month. In the southern portion of Little Belt the chief spawning season must be judged to occur in March and April, which also applies to the western portion of the Western Baltic. In the eastern portion of the Western Baltic the number of eggs is low, the highest average number per month (5) being taken in April. Also in the shallower parts of the Baltic proper off the coasts of Sealand,

Møen, and Falster the number of eggs is low, the highest number (4) also here being taken in April. In the Arcona Basin eggs were found right from February till June, the mean number being highest in June. In the Bornholm Deep considerable numbers of cod eggs were found in April, May, and June, the highest number being found in June, although the mean number was still in August fairly high (13). No investigations were made in July but, judging from the mean numbers for June and August, spawning must take place to a considerable extent also in that month.

In order to throw further light on the cod's spawning season, a number of observations on the cod's stage of maturity in our different waters in the different months will be given here. They are derived partly from the cruises of the "Thor" and "Dana" in the Danish waters and partly from the investigations carried out from the "Japetus Steenstrup" in 1928. In addition a series of analyses are included, which have been prepared from material purchased from fishermen in the course of 1929.

Fig. 10. Number of cod-eggs caught per m² surface with Hensen Net in March 1927. The figures above and below the lines state the number caught in hauls from 10 m. to surface and from bottom to surface, respectively.

For stating the stage of maturity I have made use of the scale I—VIII which is commonly used in investigating the maturity of fish. The following condition of testes and ovaries correspond to the different stages of maturity:

I. Testes very narrow, at most 2 mm. broad. Ovary small, transparent, greyish. Eggs invisible under magnifying glass.

II. Testes c. 3—4 mm. broad. Eggs 0.1—0.2 mm., visible under magnifying glass.

III. Testes c. 4—6 mm. broad. Ovaries greyish-red or very weakly yellowish-red. Eggs c. 0.2—0.3 mm., visible with the naked eye.

IV. Testes whitish, firm, c. 1 cm. broad. Ovary yellowish-red. Eggs c. 0.5 mm.

V. Testes white, c. 1 cm. broad. Ovary yellowish-red. Eggs 0.8—0.9 mm.

VI. Fish in spawning stage. Testes white. Upon their being pressed milt is expelled. Ovary yellowish-red. A greater or lesser number of eggs translucent.

Table 7. Mean Number of Cod-Eggs caught in Hensen Net per m² surface in different waters in the years 1903—1911 and 1927—1929.

	South Kattegat and the North of the Sound	Belt Sea without South Little Belt	South Little Belt	Western Part of Western Baltic	Eastern Part of Western Baltic	True Baltic E of Sealand Møen and Falster	Arkona Basin	Round Bornholm
January	..	..	1	1	0	..	0	0
February	54	8	7	13	1	..	3	0
March	45	69	40	36	2	..	0	1
April	10	15	51	34	5	4	1	36
May	1	1	8	8	2	..	0	15
June	..	0	1	0	3	2	8	50
July	..	..	..	..	..	..	..	..
August	..	..	..	..	..	..	0	13
September	..	..	..	..	..	..	..	..
October	..	..	..	..	..	..	..	0

VII. Spawning finished. Testes sunken, a little milt still remaining. Ovary sunken, containing a few residual eggs.

VIII. Testes somewhat contracted, reddish. Ovary greyish-red, somewhat contracted. This stage passes gradually into stages II—III.

Table 8 shows the stage of maturity of mature cod in the waters around Denmark at different times of the year.

As regards the Skagerak, the scanty material seems to show that the main spawning is over by the beginning of April.

In the Kattegat spawning is in full swing in March; of 63 individuals examined in March 12 had not yet commenced to spawn, 44 were in process of spawning, and 7 had spawned. At the end of April (and in May) spawning ceases in these waters; of 38 sexually mature individuals from the beginning of May only 1 was spawning, whilst all the others had finished spawning.

From the Belt Sea we possess fairly abundant analyses of the stages of maturity. An analysis from Jan. 11th 1929 showed that of 33 mature cod only 3 had finished spawning, 6 were in process of spawning, and the rest were in stages IV and V of maturity. In the last half of March spawning is in full swing, but many cod are already found which have finished spawning. In the first half of April spawning is still in full swing in Langelands Belt, and ends here about the middle of May. Some spawning cod are still found in Aabenraa Fjord at the beginning of May but the bulk of the cod have by then already spawned. In the middle of May no spawning cod were found in Smaalandshavet.

Table 8. Stage of Maturity of mature Cod in different parts of the Danish waters at various times of the year.

(Only the maturity-stages IV—VIII are included).

Stage of Maturity		IV		V		VI		VII		VIII		Total
Locality	Date	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
2 miles W. of Thyborøn	13/4 1905	..	..	..	..	1	..	4	5	..	..	10
Skagerak	18/3 1904	..	..	..	1	..	..	6	6	..	..	13
North-Kattegat	7/3 1904	..	..	4	3	17	4	..	..	..	..	28
Off Frederikshavn	10/5 1929	..	..	..	..	1	..	16[1])	21[1])	..	..	38
Round Anholt	15/3 1907	..	..	1	..	8	4	..	..	..	..	13
South-Kattegat	5-6/3 1906	..	..	4		11		7		..	..	22
SE.-Kattegat	18/4 1926	..	..	..	..	..	..	..	..	4	5	9
South of Sprogø[2])	21/3 1907	..	3	..	3	..	3	..	17	..	..	26
WNW. of Masnedsund	11/1 1929	1	10	11	2	6	0	0	3	..	..	33
Smaalandshavet	15/5 1928	..	..	..	..	..	..	7	2	2	1	12
Langelandsbelt[2])	11-13/4 1909	..	1	..	4	..	10	..	17	..	..	32
— [2])	14-29/5 1909	..	..	..	..	..	..	..	10	..	..	10
Vejsnæsbugt	16/3 1907	1		12		2		5		..	..	20
Western Baltic	8-11/5 1926	..	..	1	1	9	1	7	2	..	..	21
Aabenraa Fjord	9/5 1929	..	..	..	..	6	2	26	26	..	..	60
Hjelms Bugt	8-14/5 1928	..	..	..	..	2	1	15	11	..	..	29
Adlergrund	21/1 1929	10[3])	6[3])	2[3])	..	..	..	..	..	..	..	18
Rønne Bank	12/5 1929	1	8	10	19	5	4	2	6	..	..	55
E. of Nexø	12/5 1929	..	..	1	1	9	7	..	..	..	..	18
Round Bornholm	13-22/6 1923	..	10	..	28	267	69	11	6	..	..	391
E. of Svaneke	27/3 1928	..	..	..	..	4	..	3	1	1	..	9
		..	..	..	..	..	..	..	..	..	..	867

[1]) Also included stage VIII.

[2]) The maturity were only stated as to the females.

[3]) Besides 27 of stage III and 49 of stage I and II.

In the Western Baltic spawning has just begun by the middle of March, and in the beginning of May the greater part have not finished spawning.

In Hjelms Bay (S. of Møen) spawning is coming to an end by about the middle of May; of 29 cod subjected to examination, 3 were in process of spawning while 26 had finished spawning.

Fig. 11. Number of cod-eggs caught per m² surface with Hensen Net in April 1927. The figures above and below the lines state the numbers caught in hauls from 10 m. to surface and from bottom to surface, respectively.

In the inner portions of the Baltic proper, in the waters around Bornholm, spawning takes place a good deal later.

Off Bornholm (Adler Grund) on Jan. 31st 1929 spawning had not yet begun. No higher stage of maturity than IV was present and there were many more individuals of stage III than IV; the majority had to be assigned to stage II, i. e. it was not yet possible to judge whether they would spawn in the coming spawning season or not.

In May 1929 the cod in the waters around Bornholm were again examined with reference to their stages of maturity. A sample of 80 individuals caught on Rønne Bank on May 12th 1929 was analysed. The bulk of the sexually mature fish had not yet begun to spawn, and only a fraction had finished spawning.

In June (June 13th—22nd 1923) on the other hand, spawning was in full swing in the deeper parts of the waters around Bornholm. Of 391 cod, 17 had finished spawning (VII), 336 were in process of spawning (VI), and 38 had not yet begun to spawn (IV—V). At the end of August spawning was evidently coming to an end, as is shown by the few observations from the waters E. of Svaneke from August 27th 1928. The analyses of maturity given here thus show that it is chiefly in June—July that the cod spawn in the waters around Bornholm.

This result is in close agreement with the observations from the Hensen net fishery and with the fact that some tiny cod larvae were found just east of Bornholm at the beginning of August 1927.

If we now place side by side these observations of the stages of maturity and the quantity of eggs at different times of the year, we shall see that in the Kattegat spawning has ended by the end of April and in the Belt Sea it ceases in the course of April or May, whilst in the Western Baltic it is still continuing on a considerable scale in May, and in the waters around Bornholm it lasts until August or September. A similar displacement in the time of spawning occurs as we pass from the shallower southern parts of the North Sea to the deeper northern parts. (Fulton 1904, Redeke 1909, Heincke & Ehrenbaum 1900). The results of the investigations on the spawning of cod in the North Sea can be expressed in a condensed form as follows: spawning begins in the southern part of the North Sea in December. Off the coast of Scotland it culminates in March. On the northern North Sea Plateau it is still continuing in May; in the deep north-eastern parts of the North Sea the cod spawn as late as August, September, and October. The temperature of the water in these localities and at the times when

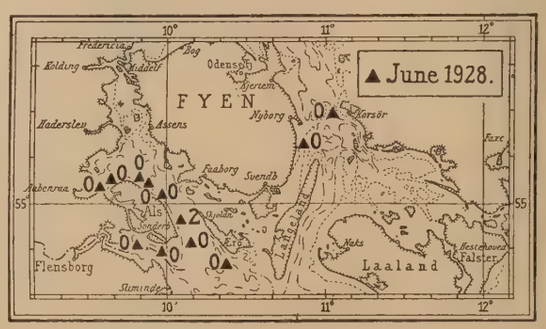

Fig. 12. Number of cod-eggs caught per m² surface by bottom-surface hauls with Hensen Net in June 1928.

the cod are spawning in the North Sea varies between 4° and 8° C.

If we examine the temperature at the times when the cod are spawning in our inner waters, we shall see that in the main spawning occurs in water of c. 3°—7° C. The lowest temperature at which cod normally spawn in our inner waters can be put at 2° C., the highest temperature being about 8° C.

Table 9 gives the temperature of the bottom water at a number of lightships from Horns Rev round the north of the Skaw and in the Kattegat, Belt Sea and the Baltic.

In the northern Kattegat, where spawning takes place in January, February, and on a much smaller scale in March and April, the temperature during the months Jan.—April varies between 4° and 6° C. In the Belt Sea where the chief spawning time is in March and where spawning still occurs to some extent in April and May, the temperature during these months varies between 4° and 6° C., and does not exceed 6° C. until June. In the Western Baltic where the spawning season is still later, namely in March, April, and May, the average temperature of the bottom water in March is only 2.3° C., rising to 3.9° C. in April and 6° C. in May; in June which is the last month in which cod eggs have been found the temperature is 7.6° C. The cod thus spawn here in the Western Baltic in water considerably colder than in the Kattegat, but the chief spawning season is also here at a time when the temperature of the water is between 4° and 6° C.

Fig. 13. Number of cod-eggs caught per m² surface by bottom-surface hauls with Hensen Net in April 1929.

Fig. 14. Number of cod-eggs per m² surface by bottom-surface hauls with Hensen Net in May 1929.

In the Baltic proper, in the waters around Bornholm, where the cod spawn in the lower water layers in the months May-August, the temperature of these water layers during these months is about 4°—5° C. Unfortunately we do not possess any systematic temperature observations from that part of the Baltic, named the Bornholm Deep, which is biologically of so great interest. The table gives the temperature observations of the bottom water at Øland's Reef Lightship (45 m.), stationed somewhat to the north of the Bornholm Deep. During the months Jan.—April the temperature remains as low as between 2.0° and 1.8° C., and does not exceed 3.0° C. until May; during the rest of the year it varies between 3° and 5° C. According to the temperature observations made from the Research Vessels in the Bornholm Deep (Table 10), the mean temperature at the bottom varies in the course of a year between c. 4° C. and slightly over 5° C. In the summer months it increases very greatly from the bottom to the surface; the question then is: — to what depths do the cod keep when spawning?

Many circumstances indicate that the cod in the Bornholm Deep spawn in the lower water layers. Thus, as mentioned on page 12, at the fishing experiments carried out in the Bornholm Deep in June 1923 and August 1928 most of the cod were caught at depths between 60 and 80 metres, several of them being in process of spawning. Moreover at the egg investigations with the Hensen Net by far the

Table 9. Mean-Temperature of Bottom-water at the Light-vessels: Horn's Rev, Læsø Trindel, Anholt Knob, Schultz' Grund, Halskov Rev, Femernbelt, Øland's Rev in the different months of the year.

Light-vessel	Horn's Rev	Læsø Trindel	Anholt Knob	Schultz' Gr.	Halskov Rev	Femernbelt	Øland's Rev
Depth m	22	30	38	26	20	28	45
	10 years	8 years	10 years	10 years	7 years	9 years	4 years
January	4.6	4.9	5.8	5.1	3.9	3.2	2.9
February	3.6	4.1	4.6	4.3	3.4	1.7	2.2
March	3.6	4.0	4.8	4.3	3.5	2.3	1.8
April	4.8	4.8	4.7	4.8	4.4	3.9	2.1
May	7.1	6.3	5.2	5.4	6.0	6.0	3.3
June	10.0	9.3	7.3	6.3	7.7	7.6	4.1
July	13.0	11.5	10.2	8.6	9.8	8.9	3.9
August	15.3	13.8	13.1	10.5	12.3	10.5	3.7
September	15.3	13.9	13.6	12.7	13.2	11.7	3.9
October	12.9	12.4	12.9	12.2	11.3	11.7	4.3
November	9.6	9.5	10.9	10.0	8.2	8.8	5.0
December	6.5	7.3	8.5	8.1	5.7	5.8	4.2

greatest number of eggs were taken in hauls from depths exceeding 50 metres to the surface, while hauls taken from shallower water than 50 metres contained far fewer cod eggs (see Chart, Fig. 6). An extract from the "Thors" journal (St. 1145 A, Bornholm Deep, $^{27}/_{7}$ /07, Petersen's Young Fish trawl at different depths) gives a similar upper limit for the distribution of cod eggs, and shows at the same time that the lowest water layers contain few or no eggs:

1 m. 50 fish eggs, mostly of Clupea sprattus.
15 m. c. 100 fish eggs,
30 m. c. 300 fish eggs.
45 m c. 1600 fish eggs, mostly of Clupea sprattus and dabs, several of cod and Onos.
55 m. c. 800 fish eggs, several of cod and Onos.
75 m. No or practically no fish eggs.

Finally, most of the larvae are found, as will be discussed on page 41, at intermediate depths, but nearer the bottom than the surface. These observations show that spawning occurs chiefly in the lower

Table 10. Mean Temperature (C°) in different Depths of the Bornholm-Deep in various months. After Gehrke (1910) and „Dana"s investigations in June 1923.

m	Febr.-March	May	June (1923)	July-Aug.	Nov.
0	2.°3	5.°2	8.°5	15.°7	8.°9
10	2.°3	4.°8	7.°7	15.°4	8.°9
20	2.°3	4.°5	8.°0	14.°4	8.°9
30	2.°4	4.°0	7.°6	10.°0	8.°8
40	2.°4	3.°5	4.°8	5.°9	8.°7
50	3.°7	3.°0	3.°7	4.°2	6.°1
60	5.°4	3.°2	3.°6	4.°4	6.°9
70			4.°1		
75	5.°2	4.°1	4.°1	4.°0	4.°7
80			4.°2		
c. 95	5.°2	4.°4	4.°1	4.°3	4.°3

water layers, not right down at the bottom but rather at about 50 to 80 metres' depth. The question is therefore — what temperatures prevail at this depth in the spawning season (May—August). Table 10 shows that the temperature in these months at depths of 50—80 metres varies between 3° and 4.4° C. At Øland's Reef Lightship (45 m.) the bottom temperature in May—August is 3.3°—4.1° C. The cod in the Bornholm Deep thus evidently spawn chiefly in water whose temperature varies between 3° and 5° C.

On the whole therefore the rule holds good in our inner waters that cod in general spawn in water of 3°—7° C., and in accordance with the different times when this is the temperature of the water it is possible to show a displacement (in the case of the Bornholm also an extension) of the spawning season from the winter through the spring months and far into the summer.

2. The Occurrence and Distribution of the Cod Larvae in the Danish Waters.

a. Previous Investigations.

The first investigations here in Denmark on the occurrence and distribution of cod fry were carried out by C. G. Joh. Petersen (1902). In 1899 and 1900 from March till June he investigated in particular the waters around Funen. As a result of his investigations he writes (p. 6): "I have of late years (1899, 1900) looked everywhere for the small young cod [by this he means both the larvae and the young bottom stages] but never found any till the end of July, and in great numbers not till the beginning of August." After August 1st he found fairly large numbers of small cod from 1 to 4 inches in length (0-Group) in 1899, but a far smaller number in 1900. He sums up the final result of his investigations in the following words: "that from the time when the eggs of the cod are deposited in February, March, and April and till the month of August the fry of the cod is missing in our seas. It then re-appears, and although scarce, it is not equally scarce every year, with an average length of 2—3 inches; but the intermediate stages, which Sars so easily observed in the Lofoten, are, as it were, unknown with us." He is of the opinion that the fry in May, June, and July are to be found somewhere out in the North Sea. He supports his theory as to the absence of the cod fry from the inner Danish waters (the waters within the Skaw) on Dahl's and Hjort's investigations in Norway which show that the cod larvae occur in the summer pelagically in the North Sea, Skagerak, and the northern Atlantic as well as on the outer oceanic coast, but that they are not to be found within the coastal belt of rocks or in the fjords. Here in our waters Petersen considered that it was the southern currents, predominating in spring, which carried the eggs out of the inner waters. In 1901 Petersen again investigated the distribution of the cod fry, and found that there were none in the Skagerak, Kattegat, and Belt Sea. Neither off Bornholm were any tiny cod fry to be found at the investigations at the end of June and the beginning of July; Petersen writes in this connexion "I must suppose that the tender fry of the cod cannot thrive at all in the whole Baltic Sea." In 1903 and 1904 these investigations were resumed by the Danish Biological Station in collaboration with the Danish Commission for the Exploration of the Sea (A. Otterstrøm 1906). At these investigations pelagic cod larvae were found everywhere in our waters with the exception of the Baltic proper; the investigation in 1904 extended from February till June. In February and March only very few larvae were found: "Up till April, therefore, we have nowhere taken the cod young in quantities, but we have found them singly in most of the Danish waters from the North Sea to the true Baltic." — "In April and May 1904 we have found the pelagic cod young in all the waters where we sought for them, but not evenly distributed everywhere." — "In April and May the pelagic cod young were most abundant in the Skagerak, and the Western Baltic, with the Little Belt, less numerous in the Kattegat and Great Belt." In June there were no cod larvae whatever in Great Belt. This is according to A. Otterstrøm, due to the hydrographical conditions, as in his opinion the currents would carry the pelagic fish fry away from the central parts of our waters; only in the deep portions of the southern Little Belt's deep basin would they be able to remain in the salt bottom water.

J. P. Jacobsen and A. C. Johansen (1908) found in 1907 and 1908 considerable numbers of cod larvae in our waters, including the Baltic near Bornholm. Whereas Petersen was of the opinion that the bulk of the cod in our waters enter them from outside, Jacobsen and Johansen write "It is beyond doubt that the Kattegat, the Belt Sea and the true Baltic have their own indigenous stock of cod, besides the stock immigrating from the Skagerak in the winter months."

In the southern part of the Belt Sea there were found in 1922 (P. L. Kramp 1924) some single tiny cod larvae, caught with the Hensen Net, on May 14th 3 larvae, 4 mm. in length, on March 28th 3 larvae, 4 mm., and on March 27th 1 larva, 4 mm.; all were thus very small and probably newly hatched.

Jacobsen and Johansen have, as mentioned above, found cod larvae in very small numbers in the deep water to the east of Bornholm. When Ehrenbaum and Strodtmann (1904) investigated fish eggs and the distribution of fish larvae in the Baltic in 1903 they found many cod eggs in the Western Baltic in February but no larvae; in the Eastern Baltic cod eggs were found in May both in the Bornholm Deep and in the Bay of Danzig. Larvae were however not found farther eastwards than in the Kadet Channel.

In 1904 when Strodtmann again investigated the spawning places of the Baltic fish he found larvae in the Bornholm Deep (1 in May and 4 in August). Later, observations by German investigators on the occurrence of cod larvae in the Baltic proper and the Western Baltic were reported by Apstein (1911), Heinen (1912), and Strodtmann (1918), without however making any essential addition to our knowledge of the occurrence and distribution of cod larvae, seeing that the investigations were first and foremost concerned with cod eggs. Mielck (1926) mentions that in April 1925 many cod larvae were caught in the Western Baltic and Baltic proper as far as Adler Grund, whereas no larvae were found in the Bornholm Deep.

b. Investigations 1923—1929.

The material on which is based the present investigation of the occurrence and frequency of cod larvae in the waters around Denmark has been partly collected on behalf of the Danish Commission for the Exploration of the Sea and partly on behalf of the Danish Biological Station. The Danish Commission for the Exploration of the Sea carried out investigations on the number of fish fry in our waters for a series of years both before and after the war, the Petersen young fish trawl being used before the war, and the ring trawl and to a lesser extent the young fish trawl after it. The trawl of C. G. Joh. Petersen is a square sack, 7 metres in length, with a rectangular mouth (c. 250 cm. broad and 130 cm. deep) $3^1/_4$ sq. metres in area; the two sides of the mouth are supported by wooden sticks. The sack is made of stramin with about 7 threads to the centimetre. While fishing is in progress it is kept spread out in the water by means of two boards each of which is connected by two lines to the wooden sticks; it is dragged in a towing bridle. The ring trawl, which has been especially used in recent years, is a modified and practicable form of the young fish trawl. It is a sack made of the same sort of stramin as used in the young fish trawl. The mouth is circular and is made fast to an iron ring which holds it open. The diameter of the ring and consequently of the mouth of the trawl is two metres, the area being thus c. 3.14 sq. metres. This is thus slightly less than that of the young fish trawl, but as we must take into account the fact that the young fish trawl is not completely distended during fishing operations the effective mouths of the two implements are practically of the same size. Their capacity for catching larvae is therefore very nearly equal and a haul with the one can be directly compared with a haul with the other. Both implements are able to fish in all water layers right from the bottom upwards; the young fish trawl is however the most suitable for the waters close to the bottom. The depth at which the trawl is operating can be ascertained from the length of wire paid out and by the angle the wire forms with the surface of the sea. At a speed of 1 nautical mile per hour we can as a rule reckon that the depth of fishing slightly exceeds one third of the length of the wire.

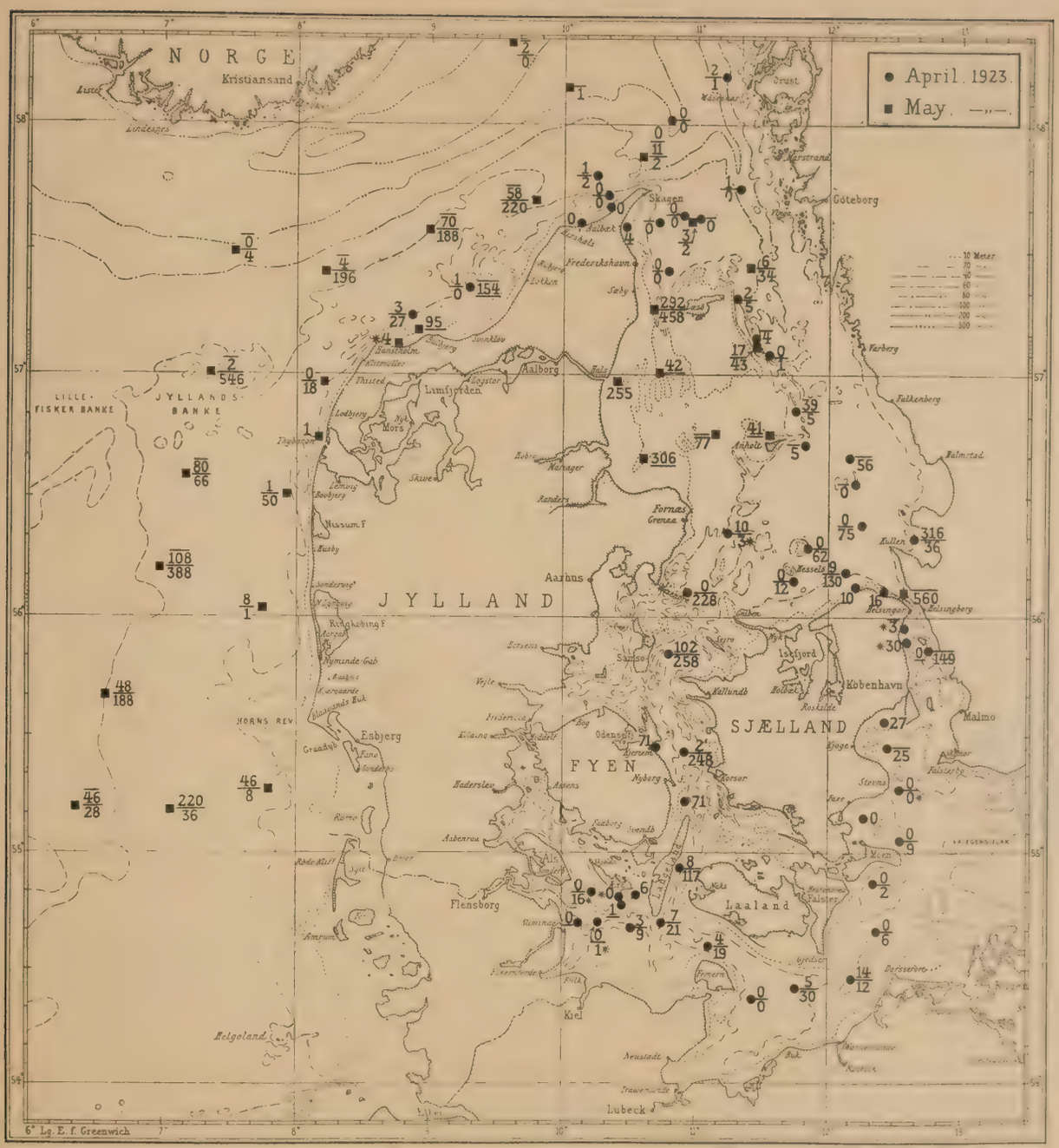

Fig. 15. Number of larvae of cod caught per 30 minutes with ring trawl or Petersen young fish trawl from April 1st to May 19th 1923. In the North Sea and the Skagerak a line above the number of larvae of the "surface" haul states that the fishing has taken place between 12 and 18 m. An * indicates that the trawl has touched the bottom.

The period during which the haul is made, i. e. the time from when the wire has been paid out until the time when the hauling up begins, lasted in most cases half an hour, in some cases one or two hours, and in some cases less than half an hour. The numbers of larvae found on the occasions when the period was not half an hour are converted in the following to numbers which correspond to this period.

When the trawl is hauled up on deck its contents are poured out into a tub and the trawl is then washed out overboard. The picking out of the larvae is then effected by taking up the water of the tub portion after portion in a glass bowl and looking through it against the background of the black laboratory table.

When the larvae have been measured, the figures give the total length in mm., calculated to the nearest whole millimetre. In many cases however the cod larvae were measured in a somewhat less

Fig. 16. Number of larvae of cod caught per 30 minutes with ring trawl or Petersen young fish trawl from May 28th—June 24th 1923. E. of 13° E. Long. the figures between the lines denote number of larvae caught between 12—34 m.

accurate manner, in half centimetres; i. e. it is stated how many cod larvae are between 5 and 9 mm., between 10 and 14 mm. and so on.

The material is obtained from investigations carried out for several consecutive years, viz. 1923—1929. During the years 1923—1926 the collections of pelagic fish fry were made from the "Dana", under the leadership of Dr. A. C. Johansen. In 1928—29 the "Dana" has not been used for fishery investigations in Danish home waters, but they have been continued from the Danish Biological Station's steamer "Japetus Steenstrup". Since the "Japetus Steenstrup" is a smaller and far less seaworthy vessel than the "Dana", it has unfortunately been impossible in 1927—1929 to carry the investigations into the waters outside the Skaw, or in spring into the Baltic proper. The investigations in the different years were carried out at different periods from March till July, as is shown by the following summary:—

1923.

April: 9 stations in the Skagerak, 20 in the Kattegat, 6 in the Sound, 5 in the Belt Sea, 12 in the Western Baltic, and 5 in the westernmost part of the Baltic proper.

May: 12 stations in the North Sea, 8 in the Skagerak, 12 in the Kattegat, 2 in the Sound, and 8 in the Belt Sea.

June: 2 stations in the Sound, 4 in the Belt Sea, 10 in the Western Baltic, and 36 in the Baltic proper as far east as Long. 16°30′ E.

1924.

April: 1 station in the North Sea, 2 in the Skagerak, 5 in the Kattegat, and 2 in the Belt Sea.

1925.

April: 4 stations in the North Sea, 9 in the Skagerak, 21 in the Kattegat, 7 in the Sound, 6 in the Belt Sea, 5 in the Western Baltic, and 5 in the westernmost part of the Baltic proper.

1926.

April: 1 station in the Skagerak, 11 in the Kattegat, and 3 in the Sound.

May: 12 stations in the Skagerak, 10 in the Kattegat, 1 in the Sound, 10 in the Belt Sea, 7 in the Western Baltic, and 6 in the westernmost part of the Baltic proper.

1927.

March: 1 station in the Kattegat, 15 in the Belt Sea, and 1 in the Western Baltic.
April: 3 stations in the Kattegat, 15 in the Belt Sea, and 3 in the Western Baltic.
May: 5 stations in the Kattegat, and 2 in the Belt Sea.
June: 1 station in the Belt Sea.

1928.

May: 7 stations in the Belt Sea.
June: 3 stations in the Kattegat, 15 in the Belt Sea, and 2 in the Western Baltic.
July: 1 station in the Kattegat.

1929.

April: 10 stations in the Kattegat, 7 in the Sound, 16 in the Belt Sea, and 4 in the Western Baltic.
May: 22 stations in the Kattegat, 49 in the Belt Sea, and 14 in the Western Baltic.
June: 17 stations in the Belt Sea.

The following number of stations have thus been taken in the different years,

1923: 151, 1924: 10, 1925: 57, 1926: 61, 1927: 46, 1928: 28, 1929: 139.
i. e. 492 stations in all in the 7 years.

From the years prior to 1914 we possess the results of a rather more scattered investigation, comprising 1904, 1905, 1906, 1907, 1908, 1909, 1911, and 1912. Taking the years separately the investigations were carried out in the different waters at the following times:—

1904.

March: 6 stations in the Skagerak, and 13 stations in the Kattegat.
April: 1 station in the Skagerak, 11 in the Kattegat, and 3 in the Belt Sea.
May: 6 stations in the Kattegat, and 14 in the Belt Sea.
June: 1 station in the Skagerak.

The fishery in 1904 was carried out partly from the "Japetus Steenstrup" (under the leadership of C. G. Joh. Petersen), partly by the "Thor" (under the leadership of A. C. Johansen). In the subsequent years the stations were taken exclusively by the "Thor".

1905.

March: 3 stations in the North Sea, 2 in the Skagerak, and 6 in the Kattegat.
April: 6 stations in the North Sea, 4 in the Skagerak, and 3 in the Kattegat.

1906.

March: 9 stations in the North Sea, 8 in the Kattegat, and 4 in the Sound.
April: 14 stations in the North Sea, and 4 in the Kattegat.

1907.

March: 3 stations in the Belt Sea, 1 in the Sound, 3 in the Western Baltic, and 7 in the Baltic Proper.
April: 3 stations in the North Sea, 5 in the Skagerak, 3 in the Kattegat, and 1 in the Sound.
May: 8 stations in the North Sea, 7 in the Skagerak, and 24 in the Kattegat.
June: 9 stations in Skagerak, 6 in the Kattegat, and 1 in the Sound.
July: 1 station in the Western Baltic, and 21 in the Baltic proper.

1908.

April: 5 stations in the Kattegat, 1 in the Belt Sea, and 2 in the Western Baltic.
May: 1 station in the Sound, 2 in the Western Baltic, and 16 in the Baltic proper.

1909.

April: 3 stations in the Kattegat, and 4 in the Belt Sea.

1911.

May: 3 stations in the Skagerak, 10 in the Kattegat, 4 in the Belt Sea, and 3 in the Western Baltic.
June: 15 stations in the North Sea, 6 in the Skagerak, and 14 in the Kattegat.

1912.

May: 1 station in the Kattegat, 6 in the Belt Sea, and 3 in the Western Baltic.

The following number of stations were thus taken in the different years,

1904: 55, 1905: 24, 1906: 39, 1907: 103, 1908: 27, 1909: 7, 1911: 55, 1912: 10.
i. e. 320 stations in all.

The material from 1904 together with more scattered observations from 1903 were published by A. Otterstrøm in 1906 and the material from 1907 and 1908 by J. P. Jacobsen and A. C. Johansen (1908). Some observations from 1899, 1900, and 1901 were published by C. G. Joh. Petersen (1902).

The material from 1904 (and previous years) is somewhat less comprehensive than the material from recent years, the hauls at the stations having been of rather short duration (as a rule only 10 minutes). The material from 1909 is rather weak, partly on account of the small number of stations but mostly because in that year another implement was used, the metre bag, i. e. a kind of ring trawl with an opening of only 1 metre's diameter; its capacity was thus only a quarter of the ring trawl's and the accuracy of the results are correspondingly diminished.

At the investigations discussed here the Danish waters were examined for cod larvae from Long. 6° E. to Long. 17° E. and from Lat. 54°20′ N. to Lat. 56°20′ N. from depths of only a few metres out to the deepest parts of the Skagerak (c. 500 metres). Table I, p. 117, gives a list of the stations where cod larvae were taken at the investigations 1923—1929. Cod larvae occur throughout the whole of the area investigated. The largest catches both of quite small cod larvae from 4 to 9 mm. and of larger ones were made in the Western Baltic. The cod larvae were also abundant in the Sound, the southern and western parts of the Kattegat, Jammerbugt, and the Danish fishing grounds of the North Sea from the Jutland Bank southwards. In the Baltic proper the cod larvae were considerably less frequent than in the other waters. The most easterly point at which cod larvae have been caught at the Danish investigations is about 40 nautical miles E. of Bornholm (Lat. 55°08′ N. and Long. 16°10′ E.). This distribution will be seen in Table 11 which gives the average number of cod larvae caught in half an hour in each month in the different waters during the years 1923—1929, and from the Charts, Figs. 15—19 and 21—25. In these charts a figure over a line denotes the number of larvae caught in the upper water layers, 0—12 m.; a figure under a line denotes the number caught in the lower layers, between the bottom and a depth of 12 metres. In order to investigate more closely the horizontal and vertical distribution of the cod larvae we must first study in detail the conditions which regulate the occurrence of the larvae in the separate localities; firstly at what distance from the surface of the water are the larvae most frequently found, and secondly

Fig. 17. Number of larvae of cod caught per 30 minutes with ring trawl or Petersen young fish trawl in April 1924.

Table 11. Total Number of Cod Larvae caught per 30 minutes with Ring Trawl or with Petersen Young Fish Trawl in March, April, May and June in the years 1923—1929. Hauls outside the 100 m curve are omitted.

	March		April												May										June							
	1927		1923		1924		1925		1926		1927		1929		1923		1926		1927		1928		1929		1923		1927		1928		1929	
	No. of		No. of		No. of		No. of		No. of		No. of		No. of		No. of		No. of		No. of		No. of		No. of		No. of		No.of		No.of		No.of	
	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls	larvae	hauls
North Sea	..	..	..	..	0	1	84	4	..	..	..	..	..	..	90	21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Skagerak.....	..	..	13	15	0	2	27	8	62	1	..	..	..	..	104	8	3	19	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kattegat.....	28	2	30	34	2	5	46	29	5	19	6	3	39	10	100	17	8	15	9	6	..	..	69	22	..	..	..	..	22	3	..	..
The Sound....	..	..	36	7	..	..	118	10	18	5	..	..	52	7	288	2	8	2	..	..	..	..	..	..	29	3	..	..	..	..	..	..
Belt Sea.....	7	32	110	8	2	2	67	10	..	..	67	26	16	16	170	9	5	19	15	4	25	9	49	49	451	5	4	2	18	15	9	15
Western Baltic.	2	1	7	20	..	..	22	10	..	..	84	6	6	4	..	..	7	14	..	..	..	..	17	14	654	10	..	..	12	2	..	..
Baltic proper..	..	..	2	9	..	..	7	10	..	..	..	..	..	..	..	..	12	11	..	..	..	..	..	..	8	56	..	..	..	..	..	..

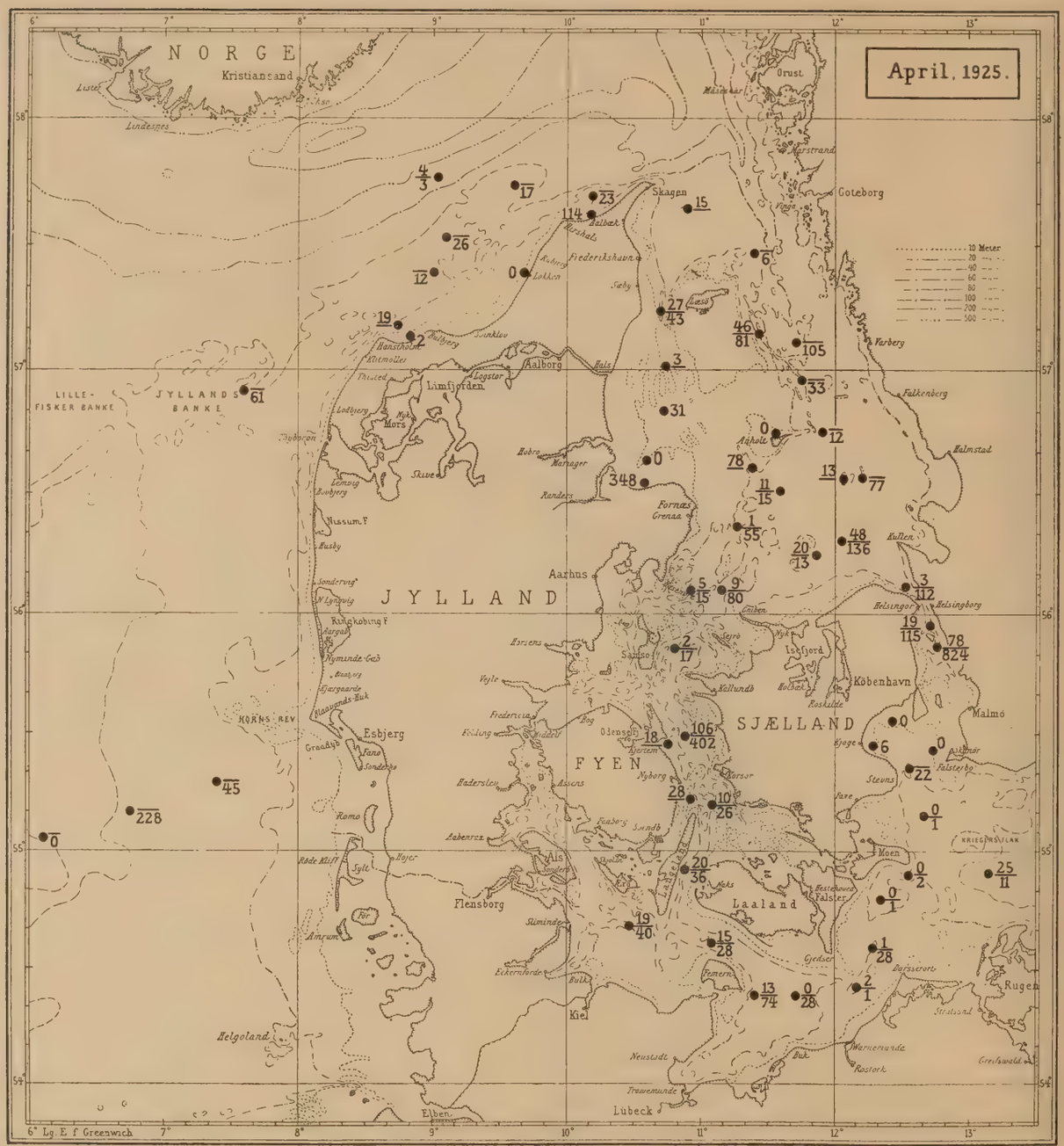

Fig. 18. Number of larvae of cod caught per 30 minutes with ring trawl or Petersen young fish trawl in April 1925.

whether they visit different water layers at different times in the 24 hours, i. e. to what an extent are they in their occurrence dependent on the intensity of light in the water or on the vertical distribution of the microplankton which varies with the intensity of the light. If we examine the charts showing the occurrence, we shall see that the larvae occur in the greatest quantities in the hauls from the lower water layers (at depths more than 12 metres), being less numerous in the hauls from the surface.

The deepest parts of our waters form however an exception to this rule, i. e. the Skagerak outside the 100 metre line and the Baltic outside the 80 metre line. In these areas cod larvae on the whole are rare, although they do occur here. Some investigations in the Skagerak in 1907 and in the Baltic in 1907, 1908, and 1923 throw light on their distribution in these waters. In Table 12 below I have tabulated a number of hauls from the deep part of the Baltic east of Bornholm, the so-called Bornholm Deep, taken from the end of May till the end of July. The figures represent the numbers of cod larvae caught in hauls of half an hour's duration at the different localities within the different depths:

Table 12.

St. No.	1145	1148	1218	3106	3107	3109	3110	3114	3117	3119	3120
Depth, m,	87	73	93	80	78	68	69	72	74	85	88
Fishing Depth,m.											
0—10	0	0	..	..	.		.	..			..
10—20	0	..	0	..	..	0	..	0	.		..
20—30	..	..	..	0	..	..	0	..	..	..	.
30—40	3	0	..	..	0	..	..	..	2	1	0
40—50	3	2	..	..	..	20	24	17	..	..	..
50—60	1	..	..	14	55	..	..	..	..	0	..
60—70	..	..	2	..	..	..	..	..	..	..	2
70—80	0	2	..	..	..	..	..	..	1	..	..
80—90	0		.	.	..	..			.	.	.
90—100	..	..	0	..	.	..			.	..	.

Cod larvae thus occur in the Bornholm Deep in the intermediate water layers between c. 35 and c. 75 metres, not being found in the upper water layers down to 30 metres' depth nor in the actual bottom water from c. 80 to c. 100 metres' depth. We have reason to seek the causes of this peculiar distribution in the particular hydrographical conditions which prevail in the Bornholm Deep. In order to show the hydrographical conditions governing the distribution of the larvae, I have in Tables 10, 13, and 14 sought to give a picture of the variations in temperature, salinity, and oxygen content in the Bornholm Deep throughout the year. Owing to the fact that we possess only very scattered data, furnished for the most part by Strodtmann (1906) and Gehrke (1910), the picture which can be given of the hydrographical conditions in the Bornholm Deep is not altogether to be relied on, but the main features may nevertheless be regarded as correct.

Table 13. Mean Salinity ($^0/_{00}$) in different Depths of the Bornholm Deep in various months. After Gehrke (1910) and "Dana"s investigations in June 1923.

m	Febr.-March	May	June (1923)	July-Aug.	Nov.
0	7.4	7.4	7.7	7.3	7.2
10			7.8		
20			7.8		
30			7.8		
40	7.5	7.7	7.9	7.6	7.9
50	8.5	9.0	10.3	8.8	8.2
60			11.7		
70			14.2		
80			15.4		
90	13.8	14.7	16.5	13.5	13.2

As will be seen from Table 13, the salinity of the surface layer in the Bornholm Deep varies between c. 7 and 8 per mille; this layer of low salinity extends down to a depth of 40 metres or more, and not until this depth is reached does the salinity rise to c. 9—10 per mille. The upper layer of low

salinity is poor in plankton, with the exception of diatoms. As regards the occurrence of copepods in the Baltic, MIELCK writes (1926, p. 90): "Im allgemeinen war aber auch die Copepodenbevölkerung über den flächeren Gebieten viel ärmer als über den Mulden [*i. a.* Bornholm Deep], wo sie sich im wesentlichen auf die mittleren und unteren Schichten beschränkten, so dass die obersten Wasserlagen fast leer blieben tags sowohl wie nachts." According to BLEGVAD (1916) the pelagic cod fry live mainly on copepods. When cod larvae do not occur in the surface layer it seems reasonable to suppose that this is due to the latter being poor in food. As mentioned on p. 40, the cod larvae also in our other waters, the Kattegat, Belt Sea, and the Western Baltic are far more numerous in the lower than in the upper water layers; this is in accordance with the fact that the upper water layers consist in the main of the Baltic water, poor in food, which flows out from the Baltic, while the lower water layers consist of salter inflowing water which is rich in food.

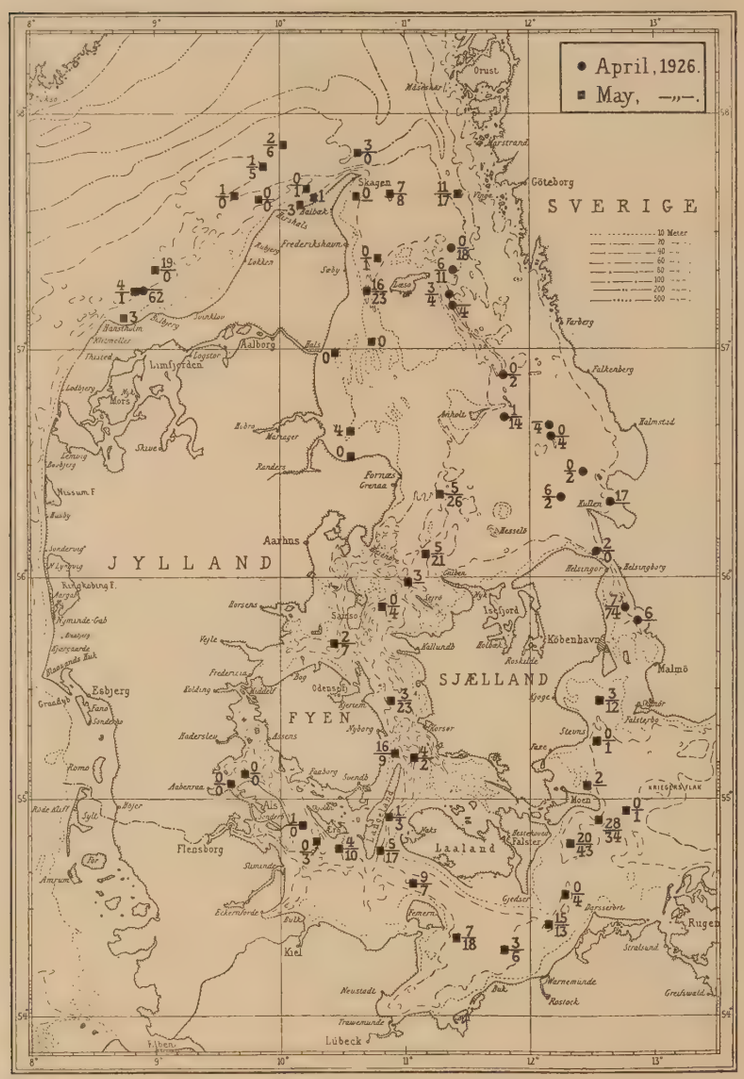

Fig. 19. Number of larvae of cod caught per 30 minutes with ring trawl or Petersen young fish trawl in April and May 1926.

In the Bornholm Deep where cod larvae occur throughout the entire summer, it is probable that the scarcity of cod larvae in the upper water layers is not only due to the latter being deficient in food but may also in some measure be caused by the high temperatures in the upper water layers in summer; the mean temperature here in July and August varies between c. 14 and c. 16° C.; in the lower water layers from 40 metres and downwards it does not however exceed 10° C.

We have seen that the lower limit for the distribution of the cod larvae in the Bornholm Deep lies at a depth of about 75 metres, the larvae being still very few in number even between 60 m. and 75 m. and only being fairly numerous between 40 and 60 metres. As the salinity steadily increases downwards until it at the bottom reaches c. 16—17 per mille, and as the temperature remains at slightly over 4° C. close to the bottom (the temperature at the bottom is c. 4° C.), it cannot be either of these factors which prevent the cod larvae from living in the lowest 20 or 30 metres of water. If we however consider the oxygen content (see Table 14) we find that in the months May—August, i. e. in the time when the larvae are present, the oxygen content is c. 6—9 ccm. per litre from 0 m. to a depth of about 60 m., varying between 2 and 6 ccm. between 60 and 80 m., and between

0.7 and 4.9 ccm. in the very lowest water layers (80—95 m.). Such low values do not normally occur anywhere else in our waters, where the oxygen content generally varies between 5.6 and 8 ccm. It is moreover a well known fact that the bottom fauna in the Bornholm Deep is poor both in species and individuals, and the cause is ascribed — no doubt correctly — to the low oxygen content. We have undoubtedly every reason to suppose that it is the low oxygen content which keeps the cod larvae away from the deep portions of the Bornholm Deep.

In the Skagerak the larvae occur in the greatest numbers in the shallower coastal water down to c. 80 metres' depth; in the deeper parts up to the 150 m. line the larvae occur only in the upper water layers. Fig. 20 shows this distribution, the number of larvae caught in half an hour being roughly given on an imaginary section through the Skagerak from the Danish coast to the Norwegian Channel. In addition is given, from the work of Astrid Cleve Euler (1917), the average number per litre of microplanktonic organisms (chiefly protozoa and peridinia) in April 1913 and 1914, and the oxygen content in August 1893 in ccm. per litre, according to the figures given by Ekman and Pettersson (1897).

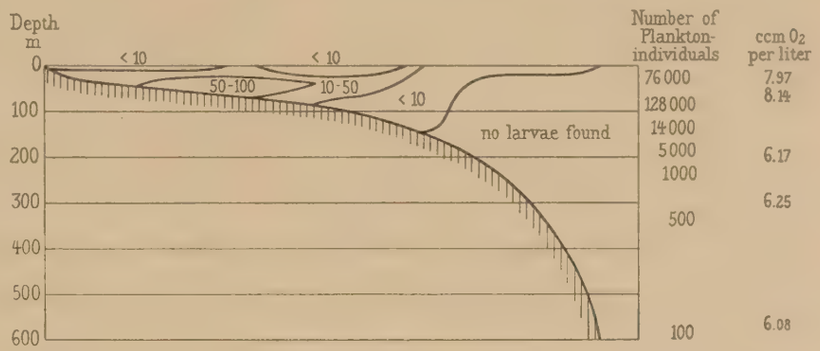

Fig. 20. The vertical and horizontal distribution of the cod larvae in Skagerak. The ciphers on the figure denote number of larvae caught per 30 minutes. Besides are stated number of planktonorganisms and quantity of oxygen per litre in various depths.

In the Skagerak there is a decrease in the oxygen content from the surface to the bottom, but only of slight extent, and the values are not nearly as low as in the bottom water in the Bornholm Deep. The oxygen content at the bottom in the Skagerak is just as high as or higher than that found in the depths of the Bornholm Deep where the cod larvae occur. There is thus no reason to suppose that the

Table 14. Quantity of Oxygen (in ccm. per Liter) in different Depths of the Bornholm Deep in various months. After Strodtmann (1906), and Gehrke (1910).

Year	1904	1905	1906	1907	1906	1907	1903	1904	1905	1906	1905	1922	1902	1903	1904	1905	1906	1928	1902	1903	1904	1905	1906
Month	February				March	April	May				July		August						November				
0 m	..	..	..	..	..	..	..	..	..	..	..	6.7	..	..	..	..	..	..	..	..	..	..	..
10 -	..	..	..	..	..	..	8.5	8.6	..	..	6.1	..	..	..	..	..	6.8	..	..	7.2	7.1	..	..
20 -	..	..	..	..	..	..	8.6	..	..	..	..	8.8	..	..	..	..	..	..	..	..	..	..	..
30 -	..	..	..	..	..	..	8.5	8.8	8.8	..	..	..	..	..	..	..	..	..	..	..	..	..	..
40 -	..	..	..	..	..	..	8.4	..	8.8	..	7.3	8.5	..	..	..	..	..	..	..	7.3	7.3	..	..
50 -	..	..	..	..	..	..	8.3	..	8.3	..	7.9	..	..	..	..	..	..	..	..	..	6.5	..	..
55 -	..	8.6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60 -	4.6	..	..	..	..	..	6.6	6.9	7.2	..	6.1	..	..	..	..	..	7.8	..	..	5.6	4.9	..	..
65 -	..	4.5	..	..	..	..	..	..	6.1	..	..	..	..	..	..	..	6.3	..	..	..	..	..	..
70 -	3.9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5.3	..	..	..	..	..	..
75 -	..	2.8	..	..	..	..	5.9	2.5	3.8	..	..	..	..	..	..	..	..	..	..	4.3	3.0	..	..
80 -	2.8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
85 -	..	2.3	..	..	..	..	4.9	..	1.6	..	..	..	..	..	2.4	..	..	..	..	..	..	..	..
90 -	2.6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2.8	..	3.7	..	..	..
c. 95 -	..	2.1	5.4	4.9	2.8	5.0	4.8	4.3	1.4	1.9	1.4	2.6	3.5	3.6	2.2	0.7	..	..	3.2	..	2.1	0.9	0.4

Fig. 21. Number of larvae of cod caught per 30 minutes with ring trawl or Petersen young fish trawl in 1927.

oxygen content regulates the occurrence of the cod larvae in the Skagerak. Salinity and temperature have not such values, in the months when the cod larvae occur, that they can be assumed to exert a restraining influence on the distribution of the cod larvae. There is however every reason to suppose that it is the small amount of light in the great depths and the consequent small quantity of plankton that are the restraining factors; the values for the quantity of plankton given in Fig. 20, from ASTRID CLEVE EULER's investigation (1917), show that there is an extremely great decrease in the amount of plankton from a depth of c. 100 m. downwards. This, according to ASTRID CLEVE EULER's close investigation, holds good for both the vegetable and animal plankton throughout all the deeper parts of the Skagerak.

In the foregoing has been described the influence exerted by salinity, temperature, oxygen content, and the amount of plankton on the occurrence of the cod larvae in the separate areas. In the following the question of the daily vertical movements of the larvae will be briefly discussed. In this connexion A. C. JOHANSEN (1925, p. 11) writes: "In the serial hauls at St. 3380 in the southern Kattegat we did not find in this case [i. e. in the case of cod larvae] as with most of the other species, any pronounced maximum in the numbers of larvae at night. The greatest number captured in the upper layers were taken between 4 and 6 p. m.; and a less pronounced maximum was observed again at midnight. The ordinary fishing experiments with the ring trawl [in 1925] however, showed that on the average, more larvae were taken by night than by day, but the difference here is not so marked as is the case of most of the other species. The average per hour was as follows:

	Kattegat	Belt Sea	Baltic	Total
Day hauls	47	20	1	30
Night hauls	73	119	25	72"

The difference in the number of larvae taken in night hauls and day hauls was thus not particularly great, at all events not in comparison with the difference found in the case of such fish larvae as those of the herring and Ammodytes. The fishing results from 1926 show no marked difference between day hauls and night hauls as regards the number

Fig. 22. Number of larvae of cod caught per 30 minutes with ring trawl or Petersen young fish trawl in 1928.

of cod larvae, 5 larvae being the average number taken in 19 night hauls and 7 larvae in 62 day hauls. Whether the hauls are made by night or day is thus of comparatively slight importance when observing the numbers of cod larvae taken, or at any rate so slight that it is unnecessary, when making a comparison of the numbers of cod larvae in one area or another and from one year to another, to state how many hauls were carried out by night and how many by day. For the comparisons made in a later section between the numbers of fry in one year and another it is a fact of importance that the difference between the night and day catches is so small seeing that in 1927, 1928, and 1929 in contrast with the years 1923—1926 no night hauls whatever were made.

Fig. 23. Number of larvae of cod caught per 30 minutes with ring trawl or Petersen young fish trawl in April 1929.

In the foregoing various factors have been mentioned as exercising a restraining influence on the distribution of the cod larvae. In the deeper water layers in the Skagerak cod larvae do not occur, but in the surface layer they occur singly and rather sparsely throughout the entire Skagerak; the reason for this must be the small quantity of plankton in the deeper water layers. In the deep portions of the Baltic E. of Bornholm cod larvae only occur very infrequently, but in the intermediate water layers they are more common, whereas they practically do not occur at all in the surface layer. It has been mentioned that the cause of their not occurring in the bottom layer is the low oxygen content, which is a feature of the bottom water in the deeper (> 70 m.) parts of the Baltic; in the surface layer it may be assumed that it is the high temperature (c. 14—16° C.) and the scanty amount of food which constitute the restraining factor. However, apart from these two areas and the shallowest coastal water and certain narrow fjords the cod larvae occur throughout all our waters.

Fig. 24. Number of larvae of cod caught per 30 minutes with ring trawl or Petersen young fish trawl in May 1929.

If we consider the two years 1923 and 1925 (Charts, Fig. 15, 16, and 18), two years in which a particularly large number of cod larvae occurred in our waters and in which investigations were made in practically all our waters, we see that the larvae do not occur everywhere with the same frequency.

In the deeper parts of the Skagerak and in the deepest north-eastern part of the Kattegat they occur rather infrequently. The reason for this is partly that the water in this latter area is in direct connexion with the Skagerak water so that the same unfavourable food conditions prevail here as in the deeper parts of the Skagerak, and partly that the cod do not spawn in these deep waters, whose stock of larvae must therefore be recruited exclusively from outside. The cod larvae are not equally distributed throughout the Kattegat, being rather more frequent in the western portion from Læsø Channel down to north of Djursland than in the eastern portions. In the south-eastern corner towards the entrance into the Sound they again are somewhat more frequent.

The Sound, Belt Sea, and to a partial extent the Western Baltic are more abundant in cod larvae than are the North Sea, Skagerak, and Kattegat. This is evident from Table 11. In April it is in the Sound and northern Belt Sea that the largest numbers are taken, but in June on the other hand it is the southern Belt Sea and the Western Baltic which present the largest catches.

Fig. 25. Number of larvae caught per 30 minutes with ring trawl or Petersen young fish trawl in June and July 1929.

As we pass further to the south and east in our waters S. of Saltholm down into the southern part of the Sound and E. of the line Gedser-Darsserort into the Baltic proper we find that the numbers of cod larvae greatly diminish. Also Jacobsen and Johansen in 1908 found considerably more larvae in the Belt Sea and the Western Baltic than in the Kattegat, Skagerak, North Sea, and the Baltic proper. A. Otterstrøm (1906) found that the cod larvae in the bottom stage — cod of 0-Group — were common in Little Belt but not in Great Belt or the Sound, and he writes "The obvious difference the three ways of communication between the Baltic and the Kattegat show with regard to the young of the cod, both the pelagic and especially the bottom-stages, is caused by the hydrographic conditions." A. Otterstrøm writes further (p. 14) ". . . . that it is owing to these that the pelagic fish eggs and fish fry are removed from the central parts of our waters partly out towards the North Sea and partly towards the Baltic proper." On the other hand he is of the opinion that in deep portions of the northern and southern Little Belt where the salt bottom water is only seldom renewed the cod larvae can develop and grow up into the bottom stage without being carried away by the current. Jacobsen and Johansen (1908) have however shown that the currents do not tend to carry eggs and larvae away from — any more than into our inner waters. Moreover the investigations of recent years show that many cod fry — both larvae and bottom stages — occur in Great Belt and the Sound. That Otterstrøm did not find this must be due to his only having material from a single year at his disposal. His observations to the effect that the southern Little Belt is particularly rich in cod larvae have on the other hand been confirmed by the investigations of recent years. The particularly abundant occurrence of cod larvae here must not however be explained by the theory that the eggs and larvae are not carried away from these waters but by the fact that they are carried into them. In addition to the southern Little Belt and to a lesser degree the waters N. of Funen, the Western Baltic and the northern portion of the Sound contain especially large numbers of cod fry. The abundance of cod fry in these areas must obviously be explained by their being dammed up. We can see from a nautical chart of the inner Danish waters that the large areas of the Kattegat where the depths exceed 20 metres extend like branches into the waters between the Danish islands; one branch enters the Belt Sea and passes to the west of Samsø into the waters N. of Funen, a second passes through Samsø Belt and Great

Belt into the Western Baltic where it forms a large deep which to the west ends in the shallow water around Aarø and Baagø, where only the very narrow channels attain a depth of c. 10—14 m., and to the east is bounded by the ridge, at most c. 17 m. deep, which connects Gedser Reef with the German coast at Warnemünde W. of the Kadet Channel; finally a fairly deep channel runs from the southern Kattegat down into the Sound where it stops at the ridge, only c. 7—10 m. deep, which runs from the south-east coast of Amager towards Skaane. The bottom currents which bring salt water from the Kattegat down through our waters follow these channels and are partially brought to a standstill by these ridges. This is shown by some salinity determinations carried out in recent years on the cruises of the "Dana". On June 5th 1923 a salinity of 26.8 per mille was found at 20 metres' depth and of 29.6 per mille at 27 metres' depth just west of the ridge between Gedser Reef and Warnemünde (6 nautical miles S.W. of Hyllekrog, 27 metres). Just east of the ridge (2 nautical miles S.S.W.$^1/_2$W. of Gedser Lightship, 26 metres) the salinity on June 5th 1923 was only 20.3 per mille at 20 metres' depth and 20.6 per mille at 26 metres, i. e. 7—9 per mille lower west of the ridge. In the northern part of the Sound (2.5 nautical miles W. of Landskrona, 41 metres) on October 2nd 1925 it was 24.9 per mille at 10 metres and 32.2 per mille at 30 metres. On the same day to the south of the ridge (5 nautical miles S.E.$^3/_4$E. of Stevns Lighthouse, 24 metres) it was found to be only 9.0 per mille at 10 metres and 10.5 per mille at 22 metres' depth.

It is thus obvious that the salt bottom water stops to a great extent at these ridges, and since it is in this very bottom water (see p. 40) that the cod larvae are chiefly found it is highly probable that they are dammed up and accumulate especially in the deep water regions in front of these ridges. In this phenomenon we can find the explanation of the particularly great abundance of cod larvae in such waters as the southern Little Belt, the Western Baltic, and the extreme south-eastern corner of the Kattegat together with the northern portion of the Sound. It explains at the same time the sudden poverty in cod larvae which is found east and south respectively of these ridges.

VI. The Growth of the Cod and its Age and Size upon attaining Sexual Maturity.

For determining the age of cod, I have almost exclusively used otoliths and only in quite rare cases are scales also used. The method of measurement alone is however commonly used for the 0-Group and in some cases for the I-Group.

The measurements given in the following denote in every case the total length, i. e. the length from the tip of the snout to the extreme end of the tail fin. The latter may vary a little in shape, being often rather concave in the younger individuals whereas it is straight or even very slightly convex in the older individuals. The length is in every case measured to the projection of the extreme point of the tail fin on to the centre line of the fish. The measurements are rounded off downwards to the nearest whole centimetre. The mean lengths calculated from the measurements are consequently too small by 0.5 cm. The real mean length is thus obtained by adding 0.5 cm. to the calculated mean length. This correction of 0.5 cm. is not made in the mean lengths given in the following.

In our waters where old cod only seldom occur, the otolith method is indisputably the best for age determination. Up to an age of about 10 years — but for the last years only by grinding the otoliths — otoliths afford reliable age determinations. The latter are carried out most reliably (and most rapidly) on completely fresh material. Otoliths which have been preserved in a dry state for a long time can still be read after having been clarified for some time in alcohol, but only with some difficulty, and in any case the same degree of certainty in the accuracy of the determination is not attained as when fresh material is used. The greater part of the age determinations on which the following investigation

is based were carried out on quite fresh material, as a rule immediately after the cod had been killed.

Age determinations by means of otoliths are best carried out when the latter are seen against a black background and are quite covered with water. The age of the three or four youngest year classes can generally be read without polishing the otoliths on a grind stone, but for the older year classes it is in the great majority of cases necessary to grind the otoliths. By polishing a section of the otolith, produced by breaking the latter in the middle, the different zones become as a rule plainly distinguishable. Often one can successfully supplement this polishing by a grinding of the otolith's convex side from the middle out towards the edge, only one must take great care not to grind away the edge as in that case it may easily happen that the outermost zone is removed. Against a black background with the light falling on it (see Fig. 26), the otolith is seen to be composed of alternate white and dark zones, its centre consisting of a white nucleus. If one holds the otolith up against the light the white rings are seen as dark and the dark rings as transparent or light; where in the following "white" or "dark" zones are mentioned this refers in every case to the appearance of the zones against a black background.

Fig. 26. Otolith of cod, 48 cm., ♂, V-Gr. fished in Aabenraa Fjord 9. Maj 1929. The otolith shows 5 dark winter-zones, the innermost being only little apparent, 5 full summer-zones (white nucleus + 4 white zones) and the beginning white zone of the spring 1929.

In the few cases where scales are used for determining age, the determination is at the same time checked by the otolith method. In our inner waters the annual rings in the scales are often indistinct and secondary rings appear; often however the annual rings are so sharply defined that they can plainly be perceived as such and in these cases the age analyses by the otolith method have given the same results as the readings of the annual rings in the scales (see Fig. 27).

In order to denote the different age groups the usual nomenclature is employed: 0-Group, I-Group, II-Group etc. An individual is taken as belonging to the 0-Group from the moment it is hatched until and including March 31st of the following year; from April 1st for one year it is called the I-Group and so on. A fish belonging to the II-Group is thus between 2 and 3 years old, being in its third year.

1. The Growth of the Cod in its first year.

When the cod larvae is hatched it is 3—4 mm. long and possesses a rather large yolk-sac; this disappears however fairly quickly, in the course of a few days. It is only seldom that larvae with yolk sacs are caught in pelagic fishing. Some measurements of larvae (with yolk-sacs) hatched on board the

"Japetus Steenstrup" at the beginning of March 1927 from eggs collected in the Belt Sea gave, immediately after hatching, the following results:

3 mm.	12 individuals
4 —	8 —

E. Ehrenbaum (1909) puts the length of the newly hatched larvae at c. 4 mm.

In the first 10 days of March 1927, 258 larvae from the Belt Sea were measured, the lengths being as follows:

mm.	No.	mm.	No.	mm.	No.
3	1	8	16		
4	37	9	11		
5	57	10	11		
6	60	11	9		
7	49	12	6	22	1

Only one was more than 12 mm. long, the majority being 5—6 mm. and the mean length being 6.5 mm. The abrupt fall in the number of the 4 mm. larvae to that of the 3 mm. larvae confirms the view that the newly hatched larvae are about 4 mm. in length.

In the first 10 days of April of the same year, 2190 larvae were measured in approximately the same localities, but only in half centimetres, into which therefore the March figures are converted for the sake of comparibility:

	March 1st—10th	April 1st—10th
< 0.5 cm.	38	10
0.5 —	193	1326
1.0 —	26	751
1.5 —	..	102
2.0 —	1	1
	258	2190
Mean length in cm.	0.7	1.0

Fig. 27. Scale of the cod from which the otolith in Fig. 26 was taken. The crosses denote the 5 winter-rings.

A considerable increase in length had therefore taken place during the month which had elapsed. At the beginning of April only a very small number of larvae were less than 0.5 cm. long, i. e. newly hatched; the majority were still between 0.5 and 1 cm., but comparatively many were nevertheless between 1 and 2 cm. In March a fairly considerable number were less than 0.5 cm., a very much smaller number were between 1 and 1.5 cm., whilst only 1 was over 1.5 cm.

In the Western Baltic where spawning occurs a little later than in the Belt Sea a number of larvae — proportionately more than in the Belt Sea — were still at the beginning of April less than 0.5 cm. On April 10th the following 176 larvae were caught and measured:

	No.		No.
< 0.5 cm.	20	1.5 cm.	5
0.5 —	109	2.0 —	2
1.0 —	40		176
		Mean length in cm.	0.9

In the Baltic proper the larvae caught at the same time are a little smaller, in accordance with the late spawning time. This is shown by some measurements from April 1925:

Length in cm.	S.W. Kattegat April 16th	Belt Sea April 16—17th	W. Baltic April 17—18th	E. of Falster April 18th
< 0.5	1	1	..	..
0.5	136	218	55	34
1.0	240	380	113	21
1.5	94	64	36	6
2.0	20	17	13	2
2.5	..	5	..	1
Total	491	685	217	64
Mean length	1.3	1.2	1.3	1.1

In comparisons such as these there appears the difficulty that we do not know how large a number of the larvae measured have grown up in the area and how many have come in from the outside. An influx of larvae from outside must raise the mean length to some extent as these larvae will be comparatively old; we are justified therefore in assuming that the rather high (considering the late spawning time) mean lengths in the Western Baltic and in the area E. of Falster are caused by the influx of older larvae. When there is a strong inflow of salt water into the Sound it rises up into the upper water layers and thus makes its way over the ridge at Drogden. In years when there is a strong inflow of salt water we therefore see that the mean length of larvae in the Baltic E. of Falster is abnormally great. In 1923 — in which year an unusually strong inflow of salt water into our inner waters took place in the spring months — the mean length of the cod larvae there was thus especially great. This is shown by the following measurements from the spring of 1923 at about the same time in the different parts of our waters:

Area	Date	Mean length in mm.	No. of Indiv.	Date	Mean length in mm.	No. of Indiv.
North Sea	$^{2-7}/_{5}$	11.5	767	..	..	..
Skagerak	$^{29}/_{4}$-$^{9}/_{5}$	11.0	556	..	..	..
Kattegat	$^{17-25}/_{4}$	10.2	632	$^{28-29}/_{5}$	14.0	124
The Sound	$^{16-19}/_{4}$	9.0	225	..	..	..
Belt Sea	$^{24-25}/_{4}$	9.5	721	$^{30}/_{5}$-$^{2}/_{6}$	13.5	3342
Western Baltic	$^{20-24}/_{4}$	8.5	78	$^{1-4}/_{6}$	14.8	2687
E. of Falster	$^{19-20}/_{4}$	12.5	77	$^{5-9}/_{6}$	16.0	249
Between 13° and 15° E. L.	..	..	..	$^{9-24}/_{6}$	10.5	37
N. and E. of Bornholm	..	..	..	$^{14-20}/_{6}$	8.0	122

In the middle of April the mean length was greater to the east of Falster than anywhere else in our waters and greater than at the same time of year in 1925 when the inflow of salt water was not particularly great. In the Western Baltic the mean length was slightly smaller than in the Belt Sea and Kattegat. The great mean length in the waters E. of Falster in the spring of 1923 must in all probability be explained by the fact that the indigenous fry are still comparatively small in number — as a consequence of the late spawning — when compared with the stock of larvae carried in from the north. In the Western Baltic however the indigenous fry are so large in number that the mean length is kept down. By the end of April the inflow of unusually salt water had only lasted about one month. At the end of May and the beginning of June when it had lasted two months or more the larvae in the waters E. of Falster were 2 mm. longer than in the Kattegat, and in the Western Baltic they were now 1 mm.

longer than in the Kattegat. In the Arcona Basin the mean length was only 10.5 mm., i. e. considerably less than in the waters E. of Falster. In the waters around Bornholm the mean length in the middle of June was only about 8 mm.

The mean length attained by the cod larvae in our waters at the beginning of June thus varies to some extent for the different areas but on the whole it may be said to lie in the neighbourhood of 1.5 cm. right from the North Sea into the Baltic as far as Kriegers Flak. To the east of Kriegers Flak on the other hand it is barely 1 cm., and quite tiny larvae are still found in September to the east of Bornholm.

Already at the beginning of June the year's brood appear in considerable numbers in the implements used for bottom fishing (trawl and tog), (see Charts giving the catches of the 0-Group, Fig. 31—33). After the end of June it is only on very rare occasions that cod larvae are caught in pelagic fishing operations in our waters, except in the Baltic E. of Bornholm. The largest larvae caught in the upper water layers in our waters in pelagic fishing operations are c. 3 cm. long; in the lower water layers — but in pelagic hauls — cod fry have been caught in isolated cases about 5 cm. in length. We can thus assume that upon attaining a length of barely 3 cm. the cod larvae begin to make their way towards the bottom, and by the time they have reached a length of 5 cm. they have quite abandoned their pelagic existence.

It has been shown in a previous section that the cod larvae for the most part remain outside the 20 metre line. As they however grow up not only do they, as mentioned above, make their way towards the bottom but they also migrate into the shallow coastal waters. This is clearly seen from the Charts showing the distribution of the 0-Group of the cod caught with the tog.

From the Chart (Fig. 31) showing the occurrence and frequency of the 0-Group in 1927 it is thus seen that in the northern Kattegat in July considerably more of the 0-Group were taken within the 10 metre line than outside it: at 4 stations within it 6 individuals were taken in half an hour in 1927 while on the same days at 18 stations between 10 and 50 metres only 0.1 individuals were taken in half an hour. The same will be seen in the Chart for 1928 (Fig. 32, S. 80):— within the 10 metre line 16 individuals (5 stations) were caught in half an hour in July in the northernmost part of the Kattegat, and 1.2 individuals (18 stations) between 10 and 50 metres. The distribution of the 0-Group in the Kattegat is also seen in Table 3. In Samsø Belt 92 individuals were caught in half an hour at 2 stations outside the 10 metre line; in the Isefjord and the southernmost part of the Kattegat 663 individuals were taken at 6 stations in half an hour within the 10 metre line. In Store Belt at 3 stations outside the 10 metre line 21 were taken in half an hour, and in Smaalandshavet (depth 12 m.) 32 were taken in half an hour at 8 stations. In the south-western Kattegat 23 individuals were taken in half an hour at 4 stations within the 10 metre line, and 0 individuals at 5 stations outside it. In 1929 far fewer individuals were taken outside the 20 metre line than within it in August and September.

Different conditions prevail however in the more brackish parts of our waters, viz. the Baltic proper between Skaane, Rügen, and Bornholm. In 1927 in these waters at the end of July and the beginning of August 2 individuals of the 0-Group were caught in half an hour at 7 stations between the 10 and 40 metre lines, and 11 individuals in half an hour at 11 stations between 40 and 80 metres. In 1928 in the same waters in August, 8 were found in half an hour at 16 stations within the 40 metre line and 19 in half an hour at 10 stations between 40 and 80 metres. The 0-Group of the cod is thus found here chiefly in the deeper water. This must be due to the coastal water here being of too low salinity for the cod fry; at Bornholm the salinity of the coastal water is between 7 and 8 per mille, while in depths of 50 metres and more salinities of 10 per mille or more are found.

In deeper water than 80 metres the 0-Group of the cod is never found in the waters east of Bornholm. It is probable that it is the low oxygen content of the water in these depths which keeps the 0-Group away, just as we have shown occurs in the case of the larvae.

We possess other evidence that the 0-Group generally makes its way, as it gradually grows up, into the shallower waters along the coast, namely that the cod fry caught in the shallower waters are larger than those caught in the deeper waters at the same time and in the same areas. At the fishing experiments in the northern Kattegat from July 9th till July 12th 1928 a number of cod of the 0-Group were caught both in the deeper and in the coastal water. The mean lengths of these cod in the different depth zones were as follows:

E. of Nordre Rønner (Læsø)	July 9th, 1928,	7½ m.	7.4 cm.	(60 individuals)
Aalbæk Bay	— 10th, —	6—13 -	6.2 -	(40 —)
Between Læsø and the Skaw	— 9—12th, —	20—50 -	5.3 -	(31 —)

A similar difference is shown by the measurements taken to the south of Funen at the end of July 1928:

Archipelago S. of Funen	July 28th	5—9 m.	7.4 cm.	(46 individuals)
Between Als and Ærø	—24th—27th	25—38 -	6.6 -	(165 —)

At the east coast of Falster there is a similar difference in length:

August 13th—14th 1928,		7—12 m.	7.9 cm.	(32 individuals)
— — — ,		20—35 -	7.3 -	(27 —)

Some measurements from previous years give the same result:

S.W. of Ærø	August 4th 1904,	10 m.	6.8 cm.	(13 individuals)
—	— - — ,	38 -	4.9 -	(31 —)

From the years 1904 till 1929 we possess measurements of over 6000 individuals caught with the tog, otter trawl, and Petersen's young fish trawl and in a few cases with the herring seine and eel weel which throw light on the growth of the 0-Group of the cod in their first year of life from the beginning of June until the end of March. This material is tabulated for the purpose of comparison according to the different areas in Table II A. Fig. 28 shows the growth curves worked out mainly from the more numerically abundant samples of this material. The catches with Petersen's young fish trawl have been obtained by bottom hauls, but as this implement does not drag nearly as hard on the bottom as does the trawl or tog and therefore catches the individuals that lead a more pelagic existence — and thus in accordance with the above the smaller individuals — these catches were not included when plotting the curve. Similarly for the sake of comparability the samples from deeper water than c. 30 m. are also omitted (with the exception however of those from the waters around Bornholm where fishing operations were only on rare occasions carried out in shallower water than c. 30 m.).

Taken as a whole the growth curves show that growth is fairly steady during the period from the beginning of June until the beginning of November. After this the growth is less rapid and not until the beginning of March does it again become rapid.

In July and August the size of the 0-Group is about the same in all our waters right from the North Sea into the Western Baltic. On about September 1st the mean length of the 0-Group is much smaller in the waters around Bornholm than in the other areas; this can however only to a partial extent be regarded as a consequence of the slower growth rate in these waters as it may be assumed to be very largely due to the late spawning time. Even at the beginning of August tiny cod larvae still occur, as mentioned on p. 31, just east of Bornholm. In the beginning of September the mean length in the North Sea is c. 11 cm., in the Kattegat c. 11 cm., in the Belt Sea c. 10 cm., E. of Falster c. 9 cm.,

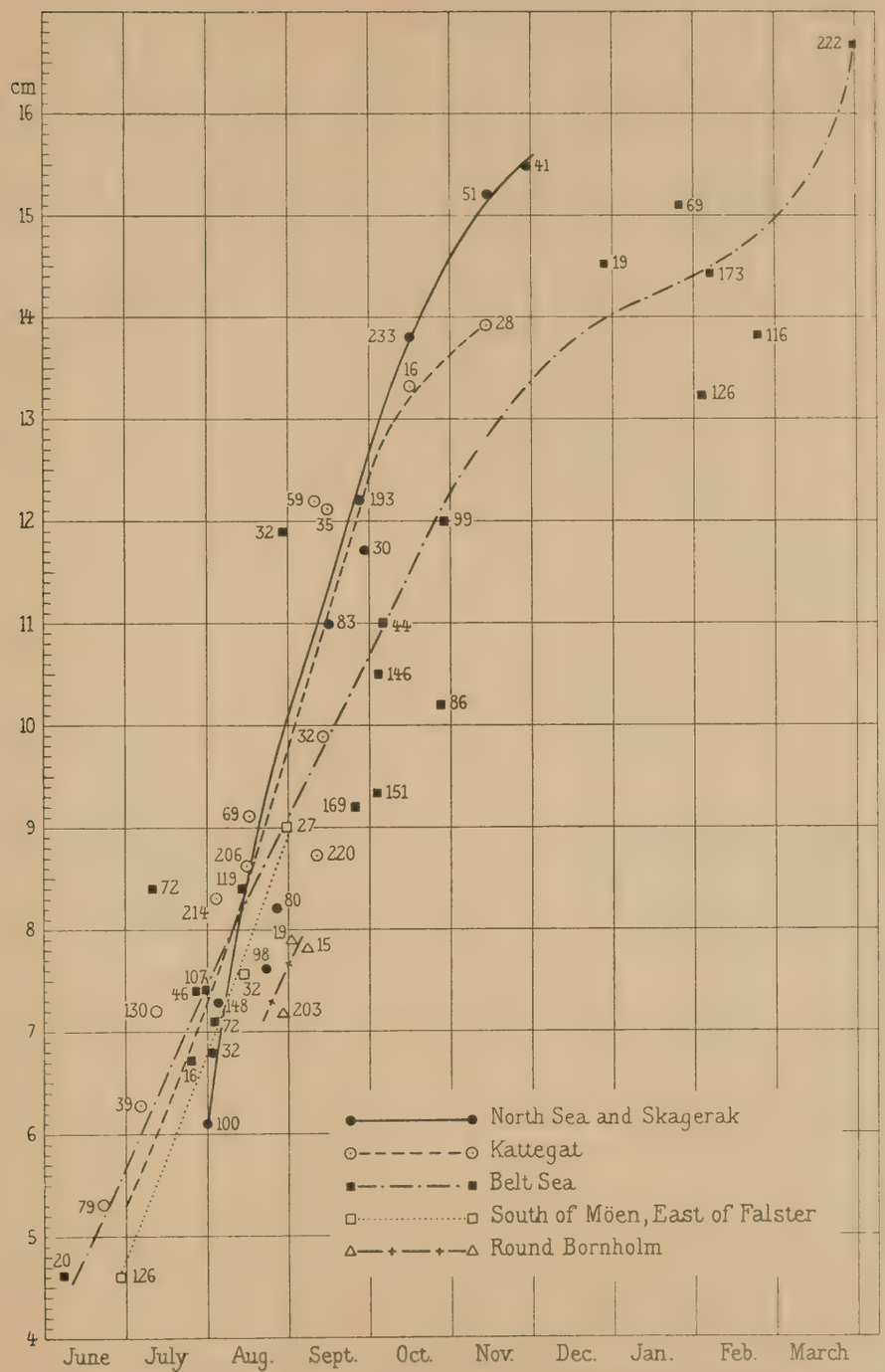

Fig. 28. Growth-curves of the 0-Group in the months June to March in various Danish waters.

and around Bornholm c. 8 cm. As regards Bornholm it should be mentioned here that the implements with which the 0-Group are usually taken are not fine-meshed enough to take the smallest individuals, i. e. those which have been hatched during the latter part of the spawning season, so that the mean

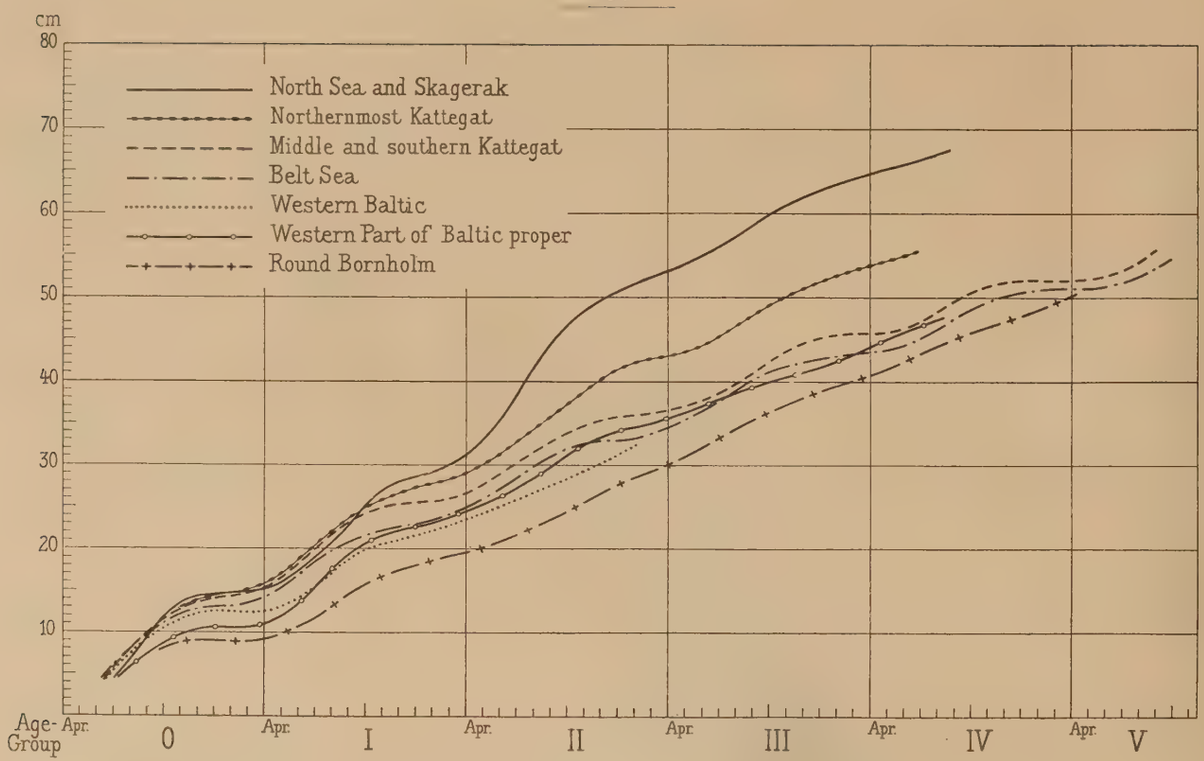

Fig. 29. Curves showing the growth of the cod from the 0-Group to the V-Group in various Danish waters.

Table 15 A. Age and Length of Cod caught in Danish Seine 10 miles NW of Thyborøn, 31. Oct. 1929; (111 specimens).

Age group	I	
Sex	♂	♀
cm.		
23	1	1
24	3	2
25	7	10
26	6	7
27	10	12
28	8	8
29	5	8
30	3	3
31	4	1
32	1	2
33	1	2
34	..	1
35	1	3
36	..	..
37	..	1
Total number	50	61
Mean length	27.6	28.0
Mean length ♂+♀	27.8	

Table 15 C. Age and Length of Cod caught in Eel-weels, Livø Broad, 10. Sept. 1929; (100 specimens).

Age group	I	
Sex	♂	♀
cm.		
27	2	..
28	2	..
29	3	..
30	7	5
31	9	8
32	6	12
33	9	8
34	7	6
35	1	12
36	2	5
37	..	2
38	1	..
39	..	2
40	..	..
41	..	1
Total number	49	51
Mean length	31.8	33.2
Mean length ♂+♀	32.5	

Table 15, B Age and Length of Cod caught in Pound-Net SE of Frederikshavn on the 10. May. 1929. (255 specimens).

Age group	I		II		III		IV		V		VI		VII	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
cm.														
26	1	..	..	..	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	1	1	..	..	..	..	..	..	..	..	..	..	..	..
29	..	1	..	..	..	..	..	..	..	..	..	..	..	..
30	..	..	2	3	..	..	..	..	..	..	..	..	..	..
31	..	..	4	1	..	..	..	..	..	..	..	..	..	..
32	..	..	4	4	..	..	..	..	..	..	..	..	..	..
33	1	..	5	5	..	..	..	..	..	..	..	..	..	..
34	..	..	4	7	..	..	..	..	..	..	..	..	..	..
35	..	..	8	7	..	..	..	..	..	..	..	..	..	..
36	..	..	7	6	..	..	..	..	..	..	..	..	..	..
37	..	..	9	7	..	..	..	..	..	..	..	..	..	..
38	..	..	3	8	1	..	..	..	..	..	..	..	..	..
39	..	..	11	10	1	..	..	1	1	..	..	..	..	..
40	..	..	8	7	..	..	..	..	..	..	..	..	..	..
41	..	..	3	9	..	..	1	..	..	..	..	..	..	..
42	..	..	9	4	1	..	..	2	..	..	..	..	..	..
43	..	..	4	2	1	1	1	1	..	..	..	..	..	..
44	..	..	4	3	2	..	..	1	..	..	..	..	..	..
45	..	..	3	6	1	1	..	..	..	1	..	..	..	..
46	..	..	2	3	1	1	1	1	..	..	..	..	..	..
47	..	..	1	2	..	..	..	3	..	..	..	..	..	..
48	..	..	..	5	..	..	..	..	..	..	..	..	..	..
49	..	..	..	1	1	..	2	1	..	..	..	..	..	..
50	..	..	..	2	..	1	..	3	..	..	..	..	..	..
51	..	..	..	..	..	1	..	..	..	..	..	..	..	..
52	..	..	..	..	..	1	1	2	..	..	1	..	..	..
53	..	..	..	..	..	1	..	..	..	..	..	..	..	..
54	..	..	..	1	..	..	1	..	..	..	..	..	..	..
55	..	..	..	..	..	..	..	1	..	..	..	..	..	..
56	..	..	..	..	1	..	1	..	..	..	..	..	..	..
57	..	..	..	..	..	..	..	1	1	..	..	..	..	..
58	..	..	..	..	..	1	..	..	1	..	..	..	..	..
59	..	..	..	..	..	..	1	..	..	..	..	..	..	..
60	..	..	..	..	..	..	..	1	..	..	..	..	..	..
61	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62	..	..	..	..	..	..	..	..	..	1	..	..	..	..
63	..	..	..	..	..	..	..	..	..	..	..	..	..	..
64	..	..	..	..	..	..	..	..	..	..	..	..	..	..
65	..	..	..	..	..	..	..	..	..	..	..	..	..	..
66	..	..	..	..	..	..	..	..	..	..	..	..	..	..
67	..	..	..	..	..	..	..	..	..	..	..	..	..	..
68	..	..	..	..	..	..	..	..	..	..	..	..	..	..
69	..	..	..	..	..	..	..	..	..	..	..	..	..	..
70	..	..	..	..	..	..	..	..	..	..	..	..	..	..
71	..	..	..	..	..	..	..	..	..	..	..	..	..	..
72	..	..	..	..	..	..	..	..	..	..	..	..	..	..
73	..	..	..	..	..	..	..	1	..	..	..	..	..	..
74	..	..	..	..	..	..	..	..	..	..	..	..	..	..
75	..	..	..	..	..	..	..	..	..	..	..	..	..	..
76	..	..	..	..	..	..	..	..	..	..	..	..	..	..
77	..	..	..	..	..	..	..	..	..	..	..	1	..	..
78	..	..	..	..	..	..	..	..	..	..	..	..	..	..
79	..	..	..	..	..	..	..	..	..	..	..	1	..	..
.														
88	..	..	..	..	..	..	..	..	..	..	..	..	..	1
.														
99	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Total number	3	2	91	103	10	8	9	19	3	2	1	2	..	2
Mean length	29.0	28.5	38.1	39.3	44.6	49.8	49.9	49.8	51.3	53.5	52.0	78.0	..	93.5
Mean length ♂ + ♀	28.8		38.7		46.9		49.8		52.2		69.3		93.5	

Table 15 D. Age and Length of Cod caught in Pound-Net in Kerteminde Bay on the 2. May 1929. (100 specimens).

Age group	II		III		IV		V		VI		VII		?
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
cm.													
26	1	..	..	..	..	..	..	..	..	..	..	..	..
27	1	1	..	..	..	..	..	..	..	..	..	..	..
28	1	4	..	..	..	..	..	..	..	..	..	..	..
29	3	5	..	..	..	..	..	..	..	..	..	..	..
30	1	3	..	..	..	..	..	..	..	..	..	..	..
31	3	2	..	..	..	..	..	..	..	..	..	..	..
32	4	..	..	..	1	..	..	..	..	..	..	..	..
33	1	1	..	..	..	..	..	..	..	..	..	..	..
34	1	..	..	..	..	..	..	..	..	..	..	..	..
35	1	..	..	1	..	..	..	..	..	..	..	..	..
36	..	2	..	..	..	..	..	..	..	..	..	..	..
37	..	..	..	..	..	1	..	..	..	..	..	..	..
38	..	..	..	..	..	..	..	..	..	..	..	..	..
39	..	..	..	..	..	..	..	..	..	..	..	..	..
40	1	..	..	1	..	1	..	..	..	..	..	..	..
41	..	..	..	..	1	1	..	..	..	..	..	..	..
42	..	..	..	..	1	..	..	..	..	..	..	..	..
43	..	1	1	1	..	1	..	..	..	..	..	..	..
44	..	..	..	..	..	1	..	..	..	..	..	..	..
45	..	..	2	1	2	1	..	..	..	..	..	..	..
46	..	..	..	..	..	2	1	..	..	..	..	..	..
47	..	..	..	..	1	2	..	..	..	..	..	..	..
48	..	..	..	..	6	3	..	..	..	..	..	..	..
49	..	..	..	..	3	..	..	..	1	1	..	..	..
50	..	..	..	..	3	2	..	..	..	..	..	..	..
51	..	..	..	1	2	3	..	..	..	..	..	..	..
52	..	..	..	..	..	..	2	..	1	1	..	..	..
53	..	..	..	..	..	..	..	..	..	..	..	..	..
54	..	..	..	..	1	..	..	..	..	1	..	..	..
55	..	..	..	..	..	..	2	..	..	..	..	..	..
56	..	..	..	..	..	1	..	..	..	..	..	..	..
57	..	..	..	..	..	..	..	..	..	1	..	..	..
58	..	..	..	..	..	..	..	..	..	..	..	..	..
59	..	..	..	..	..	..	..	..	..	..	..	..	..
60	..	..	..	..	..	..	..	..	..	..	..	..	1
61	..	..	..	..	..	..	..	..	..	..	..	..	..
62	..	..	..	..	..	1	..	..	..	..	..	..	..
63	..	..	..	..	..	..	..	..	..	..	..	..	..
64	..	..	..	..	..	..	..	..	..	..	..	..	..
65	..	..	..	..	..	..	..	..	..	..	..	..	..
66	..	..	..	..	..	..	..	..	..	..	..	..	..
67	..	..	..	..	..	..	..	..	..	..	..	..	..
68	..	..	..	..	..	..	..	..	..	..	..	..	..
69	..	..	..	..	..	..	..	..	..	..	..	..	..
70	..	..	..	..	..	..	..	..	..	..	..	..	..
71	..	..	..	..	..	..	..	..	..	..	..	..	..
72	..	..	..	..	..	..	..	..	..	..	..	..	..
73	..	..	..	..	..	..	..	..	..	..	..	1	..
Total number	18	19	3	5	21	21	5	..	2	4	..	1	1
Mean length	31.2	30.7	44.3	42.8	47.3	47.5	52.0	..	50.5	53.0	..	73.0	..
Mean length ♂ + ♀ ...	30.9		43.4		47.4		52.0		52.2		73.0		..

Table 15 E. Age and Length of Cod caugth on Hooks 3 miles WNW of Masnedsund, 10 m; 11. Jan. 1929; (60 specimens).

Age group	I		II		III		IV		VII	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
cm.										
35	1	..	..	..	..	..	..	..	..	..
36	..	1	..	..	.	.	.	..	..	
37	.	.	1	.	..	..	..	..	..	..
38	..	..	..	..	..	..	..	..	..	..
39	..	..	..	..	..	2	..	..	..	..
40	..	..	..	1	..	1	..	..	..	.
41	..	..	..	1	2	..	..	..	..	.
42	..	..	..	..	3	2	..	..	..	..
43	..	..	..	..	3	1	..	..	..	..
44	..	..	1	1	4	3	..	1	..	..
45	..	..	..	..	4	4	..	..	..	..
46	..	..	..	..	1	3	..	..	..	..
47	..	..	..	..	1	2	..	..	..	..
48	..	..	..	..	2	1	..	..	..	..
49	..	..	..	..	3	2	..	..	..	..
50	..	..	..	..	..	1	..	..	..	..
51	..	..	1	..	..	..	..	..	..	..
52	..	..	..	..	..	1	..	1	..	.
53	..	..	..	..	..	2	..	..	..	.
54	..	..	..	..	..	..	..	..	..	..
55	..	..	..	..	1	..	..	..	..	.
:	..	..	..	..	..	..	..	..	..	..
83	..	..	..	..	..	..	..	..	..	1
Total number	1	1	3	3	24	25	..	2	..	1
Mean length	35.0	36.0	44.0	41.7	45.2	45.7	..	48.0	..	83.0
Mean length ♂ + ♀	35.5		42.9		45.4		48.0		83.0	

length calculated for Bornholm is somewhat too high. This is also shown by the circumstance that at investigations in April (1926) the mean length of the I-Group was only 8—9 cm.

Strodtmann (1906) found mean lengths of 11—13 cm. in the 0-Group in the Western Baltic in November and December.

In November the mean length of the 0-Group throughout our waters can be put at the following approximate values:

North Sea	15 cm.	Kattegat	14 cm.
Belt Sea	13 —	Western Baltic	13 —
Western parts of the Baltic proper	11 cm.	Waters around Bornholm	c. 8—9 cm.

2. The Growth of the Cod after its first Year.

The growth of the cod after its first year of life in our different waters, can be seen from Table II, B—F, which includes cod caught at the scientific fishing experiments. In Fig. 29 are given the growth curves for each area, drawn up from the more numerically abundant samples of this material (for the North Sea and Northern Kattegat the material given in Table 15 A—B is included).

In the second and third years of the cod's life (I- and II-Groups) growth is considerably more

Table 15 F. Age and Length of Cod caught in Aabenraa Fjord, 9. May 1929; (101 specimens).

Age group	II		III		IV		V	
Sex	♂	♀	♂	♀	♂	♀	♂	♀
cm.								
32	2	1	..	..	..	..	..	..
33	2	..	..	..	..	..	..	..
34	2	3	..	..	..	..	..	..
35	1	..	..	1	1	..	..	..
36	..	3	..	..	..	..	..	..
37	2	1	..	..	..	..	..	..
38	..	..	..	..	1	..	..	..
39	1	1	..	..	2	1	..	..
40	..	..	..	..	..	2	..	..
41	..	..	1	..	2	..	..	..
42	..	1	..	..	2	1	..	..
43	..	..	..	..	..	1	..	..
44	1	..	..	..	3	2	..	..
45	1	..	..	..	2	1	..	..
46	..	..	..	..	6	4	..	..
47	..	..	..	..	4	2	..	..
48	..	..	..	..	1	4	1	..
49	..	..	..	..	1	4	1	1
50	..	..	..	..	1	..	..	..
51	..	..	..	..	2	2	1	..
52	..	..	..	..	1	1	2	..
53	..	..	..	..	..	2	..	..
54	..	..	..	1	2	2	..	1
55	..	..	..	..	2	1	..	..
56	..	..	..	..	..	..	..	..
57	..	..	..	..	..	..	..	..
58	..	..	..	..	1	..	..	..
59	..	..	..	..	..	..	..	..
60	..	..	..	..	1	..	..	..
61	..	..	..	..	1	..	..	..
62	..	..	..	..	..	..	..	1
63	..	..	..	..	..	..	..	..
64	..	..	..	..	..	..	..	..
65	..	..	..	..	..	..	1	..
66	..	..	..	..	..	1	..	..
Total number	12	10	1	2	36	31	6	3
Mean length	36.3	36.0	41.0	44.5	47.3	48.1	52.8	55.0
Mean length ♂ + ♀	36.1		43.3		47.7		53.6	

rapid in the North Sea and Skagerak than anywhere else in our waters. In the second year the growth in these waters is, according to the investigations undertaken here, about 15 cm. whilst in the Kattegat and the other inner waters it varies between 9 and 12 cm. In the third year the growth in the North Sea and Skagerak is c. 20 cm., varying in our other waters between 8 and 15 cm.

In the fourth year the growth varies in the North Sea, Skagerak, Kattegat, and Belt Sea between c. 8 and c. 11 cm.

In the waters around Bornholm the growth is apparently (see below) more or less the same for all age groups. The analyses show an increment of growth of c. 10 cm. for each of the first 5 years.

The growth which these investigations have revealed in the eastern part of the North Sea, off the west coast of Jutland, and E. of Long. 5°E. is somewhat greater than that previously observed in the more western parts of the North Sea. Damas, 1909, p. 93, gives the following values in the different years for the growth of the cod of the western and southern North Sea:

1st year	12—15 cm.	4th year	10 cm.
2nd —	12—15 —	5th —	10 —
3rd —	10 —		

The growth in the first year is the same as off the Danish coast, in the second year it is somewhat smaller and in the third year much smaller, whilst in the fourth year it is again the same in both areas. According to Michael Graham (1929), the growth of the 1923 year class in the waters W. of the Dogger Bank was in the 1st year c. 12 cm., in the 2nd c. 7 cm., in the 3rd 9 cm., i. e. much smaller than off the Danish coast.

A number of growth determinations in the Baltic proper were carried out by Chr. Hessle (1923).

Table 15 G. Age and Length of Cod caugth on Hooks 3 miles S of Arnager, Rønne Bank, (Bornholm), c. 20 m. on the 12. May 1929; (80 specimens).

Age group	II		III		IV		V		VI	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
cm.										
31	..	1	..	..	..	..	..	..	..	..
32	..	1	..	..	..	..	..	..	..	..
33	..	..	..	1	..	..	..	..	..	..
34	1	1	..	..	..	..	..	..	..	..
35	..	..	..	2	..	..	..	..	..	..
36	..	2	..	1	..	1	..	..	..	..
37	..	..	..	..	1	1	..	..	..	..
38	..	1	..	..	..	..	..	..	..	..
39	..	..	..	..	..	..	..	..	..	..
40	..	..	..	..	..	2	..	..	..	..
41	..	..	1	2	..	..	..	..	..	..
42	..	..	..	2	1	..	..	..	..	..
43	..	..	..	2	2	2	..	..	..	..
44	..	..	1	..	1	5	..	..	..	..
45	..	..	..	1	..	1	..	..	..	..
46	..	..	..	..	..	1	..	1	..	..
47	..	..	..	1	1	1	..	..	..	..
48	..	..	..	..	1	1	..	..	..	..
49	..	..	..	..	1	1	..	..	..	..
50	..	..	..	..	..	1	..	..	..	..
51	..	..	..	..	1	..	..	..	..	..
52	..	..	..	..	1	1	..	..	..	..
53	..	..	..	..	1	3	..	..	..	..
54	..	..	..	..	1	1	..	..	..	..
55	..	..	..	..	..	3	..	..	..	..
56	..	..	..	1	..	..	..	..	..	..
57	..	..	..	..	..	1	..	1	..	..
58	..	..	..	..	1	1	..	..	..	..
59	..	..	..	1	..	..	..	..	..	..
60	..	..	..	..	..	..	..	..	..	..
61	..	..	..	..	..	.	..	..	..	..
62	..	..	..	..	..	3	..	..	1	..
63	..	..	..	..	..	1	..	..	..	..
64	..	..	..	..	..	1	..	..	..	..
65	..	..	..	..	..	1	..	..	..	..
66	..	..	..	..	..	..	1	..	..	..
67	..	..	..	..	..	1	..	..	..	1
68	..	..	..	..	1	..	1	..	..	..
69	..	..	..	..	..	..	..	..	..	..
70	..	..	..	..	..	..	..	..	..	..
71	..	..	..	..	..	..	..	1	..	..
72	..	..	..	..	..	..	..	1	..	..
73	..	..	..	..	..	..	..	..	..	..
74	..	..	..	..	..	..	..	..	..	..
75	..	..	..	..	..	..	..	1	..	..
Total number	1	6	2	14	14	34	2	5	1	1
Mean length	34.0	34.5	42.5	42.7	49.2	51.0	67.0	64.2	62.0	67.0
Mean length ♂ + ♀	34.4		42.7		50.5		65.0		64.5	

Table 15 H. Age and Length of Cod caught SW of Rønne (Bornholm) near the Adler Grund, c. 20—30 m. on the 31. January 1929; (94 specimens).

Age group	I		II		III		IV		V		?	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
cm.												
30	..	1	..	1	..	..	..	..	..	..	..	..
31	1	..	..	..	..	..	..	..	..	..	..	..
32	..	..	1	..	..	..	..	..	..	..	..	..
33	..	..	4	2	..	..	..	..	..	..	..	..
34	..	..	2	3	..	..	..	..	..	..	..	..
35	..	..	4	3	..	..	..	..	..	..	..	1
36	..	..	2	5	1	..	..	..	..	..	..	..
37	..	..	..	3	1	..	..	..	..	..	..	1
38	..	..	..	2	1	1	..	..	..	..	..	..
39	..	..	..	1	1	3	..	..	..	..	..	..
40	..	..	..	3	2	5	..	1	..	..	..	..
41	..	..	..	..	2	2	1	..	..	..	1	..
42	..	..	2	1	2	1	1	1	..	..	..	..
43	..	..	1	..	..	5	..	..	..	..	..	..
44	..	..	..	..	1	1	..	1	1	..	..	..
45	..	..	..	..	2	1	1	..	..	..	..	..
46	..	..	..	..	..	..	1	1	1	..	..	..
47	..	..	..	..	..	1	2	..	..	..	..	..
48	..	..	..	..	..	1	..	1	..	..	..	..
49	..	..	..	..	..	1	..	..	..	..	..	..
50	..	..	..	..	..	..	1	..	..	..	..	..
Total number	1	1	16	24	13	22	7	5	2	..	1	2
Mean length	31.0	30.0	35.7	36.3	40.8	42.1	45.4	44.0	45.0	..	..	..
Mean length ♂ + ♀	30.5		36.1		41.6		44.8		45.0		..	

He gives the length at the end of the first period of growth in the southern part of the Baltic as c. 10 cm. (p. 46), which thus agrees with the results of the Danish investigations in the waters around Bornholm. Chr. Hessle considers (p. 60) that his material is unsuitable for judging the lenght of the II-Group, but for the older year classes he gives the following approximate mean lengths for the southern Baltic:

3rd year	c. 30 cm.	6th year	c. 60 cm.
4th —	- 40 —	7th —	- 67 —
5th —	- 50 —		

Hessle remarks in this connexion "The younger marketable year classes thus grow about 10 cm. per year within this area." The growth here thus approximates very nearly to that found at the Danish investigations in the waters around Bornholm.

If we consider the growth curves of the cod in Danish waters in Fig. 29 we see that there is a striking difference as regards growth between the two extreme points of the area investigated: the North Sea—Skagerak and the waters around Bornholm. In the North Sea and Skagerak the growth is very rapid in the 2nd and 3rd years, slower in the 4th, and still slower in the 5th year. Off Bornholm on the other hand the rise of the growth curve remains constant throughout all the years for the age groups under investigation. This difference in the growth curves must be explained by the immigration that takes place of the somewhat older year classes from our other waters (Kattegat and Belt Sea) to the areas around Born-

Table 16. Mean Length in cm. of the different Age Groups of Cod caught by Fishermen in 1929 (drawn together from Table 15 A-H). For the individuals from the samples from January 1929 the age groups are stated as if the fish were caught after April 1st. The numbers of individuals are stated in brackets.

Age group	I	II	III	IV	V	VI	VII	VIII
Off Thyborøn, Oct. 31st, 1929	27.8 (111)	..	..	..	..	..	..	..
SE. of Frederikshavn, May 10th, 1929	28.8 (5)	38.7 (194)	46.9 (18)	49.8 (28)	52.2 (5)	69.3 (3)	93.5 (2)	..
Livø Broad, Sept. 9th, 1929	32.5 (100)	..	..	..	..	..	..	..
Kerteminde Bay, May 2nd, 1929	..	30.9 (37)	43.4 (8)	47.4 (42)	52.0 (5)	52.2 (6)	73.0 (1)	..
WNW. of Masnedsund, Jan. 11th, 1929	..	35.5 (2)	42.9 (6)	45.4 (49)	48.0 (2)	..	..	83.0 (1)
Aabenraa Fjord, May 9th, 1929	..	36.1 (22)	43.3 (3)	47.7 (67)	53.6 (9)	..	..	..
Rønne Bank, May 12th, 1929	..	34.4 (7)	42.7 (16)	50.5 (48)	65.0 (7)	64.5 (2)	..	..
Adler Grund, Jan. 31st, 1929	..	30.5 (2)	36.1 (40)	41.6 (35)	44.8 (12)	45.0 (2)	..	..

holm (see p. 20). As this immigration includes chiefly individuals which have grown more rapidly than the cod indigenous to the Bornholm area the mean length of the latter is raised within the older age groups which especially take part in this immigration. That such an immigration occurs is proved by the racial analyses of cod from Bornholm. In the samples from January 1929 and May 1929 (the age groups in the January sample are tabulated as if from the 1st of April next, for the sake of comparability) the different age groups have the following number of rays in the 2nd dorsal fin (the figures in brackets denote the number of individuals):

Age group	II	III	IV	V	VI
No. of rays	17.67 (9)	17.26 (55)	17.47 (83)	18.11 (19)	17.75 (4)

An appreciable rise in the number of rays from the younger to the older year classes is found to exist here, which again shows that the older year classes are more mixed with extraneous cod than are the younger.

All the age and growth analyses quoted in the foregoing are based on the scientific fishing experiments. In the following will be given some observations on fish caught in commercial fishing operations at the beginning of May 1929. Table 15 A—H contains size and age columns for each analysis.

In Table 16 the mean length of the separate age groups in the different samples examined are tabulated.

It is clear from this Table that the growth during the first three years of the year classes here investigated was more rapid in the North Sea and the northern Kattegat than in our other waters, being slowest in the waters around Bornholm. After the third year however it appears to be as rapid in the latter area as in our other waters. The proportion between the growth rates in the different waters is thus the same as that shown by the analyses of cod from the scientific fishing experiments (p. 60). The mean lengths observed in the samples from the commercial fishery slightly exceed those found in the fishing experiments. As regards the youngest age groups this may be explained by the fact that the smallest fish are not fished upon in the same degree as the larger ones. As regards the older age groups it is possibly due to the fact that in the fishing experiments only rather few individuals of the older age groups were caught.

3. Different Growth Rate in Males and Females.

Determination of sex was also carried out on a part of the material which was used for age and growth determinations, but not on individuals belonging to the 0-Group.

In Table 17 the more numerically abundant samples of this material are tabulated. Already in the 2nd year (I-Gr.) there appears a distinct difference in the growth of males and females. The females are on an average nearly 1 cm. longer than the males, the difference thus not being great. This difference does not increase in the 3rd year. Also in the 4th year it is only c. 1 cm. In the 5th year a rather larger difference between males and females appears in some of the analyses. We only possess an analysis of one sample at all abundant in individuals of the V-Group (6th year), from Schultz's Grund; in this sample the average length of the females is 3 cm. greater than that of the males. For the older age groups the material is too sparse for any reliable conclusion to be drawn.

The females have thus already in their 2nd year a short lead (of 1 cm.) in length over the males. The analysis for Schultz's Grund tends to show that this lead increases a little in the course of years.

Also among the Icelandic cod the growth of the females is a little more rapid than that of the males (B. Sæmundsson 1923).

The material tabulated in Table 17 tends to show that the females become both larger and older than the males; of 53 individuals belonging to the VI-Group, 23 were males and 30 females, and in the VII-Group there were 4 males and 11 females. We are led to the same conclusion by the classification below of 14 large cod, 78—123 cm. in length, which from time to time were purchased and examined:

Size cm.	Weight gr.	Sex	Age Group	Date	Locality
78	4000	♀	VI	$^{21}/_{4}$ 29	W. of Masnedø
84	6000	♀	VI	$^{15}/_{1}$ 29	—
92	6750	♀	VI	$^{18}/_{10}$ 29	—
92	6500	♀	VIII	$^{18}/_{10}$ 29	—
92	5700	♀	IX	$^{3}/_{5}$ 29	W. of Reersø
94	7800	♀	c. VII	$^{12}/_{12}$ 21	The Sound
95	6750	♂	VIII	$^{1}/_{5}$ 29	Kerteminde Bay
95	7000	♀	VII	$^{22}/_{4}$ 29	W. of Masnedø
98	6500	♀	VIII	$^{22}/_{4}$ 29	—
99	6500	♀	VIII	$^{9}/_{4}$ 29	—
101	9300	♀	XI	$^{18}/_{10}$ 29	—
109	7000	♀	IX	$^{21}/_{4}$ 29	—
110	10000	♀	c. X	$^{17}/_{12}$ 21	The Sound
123	..	♀	XII	$^{20}/_{10}$ 05	N. of the Skaw

Among these 14 large cod there is thus only 1 male.

The cod caught in the waters within the Skaw are seldom above 0.9—1 metre in length, corresponding to a weight of c. 7—10 kg.[1] The cod of this size which have been examined have been between 8 and 11 years old.

In the Skagerak and North Sea the cod evidently become considerably larger, cod about 1 metre in length being fairly often taken.

Krøyer (1843—1845) writes as follows on the size which cod can attain in Danish waters: "Off the west coast of Jutland cod are commonly taken weighing 20—30 ℔ (10—15 kg) and more. Also in

[1] According to information supplied by fishermen from the Sound, the largest cod caught in the Sound have weighed c. 12—15 kg.

Table 17. Mean Lengths in cms. of Males and Females of different Age Groups. (Number of individuals measured in brackets).

Age group	I		II		III		IV		V		VI		VII	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Off Frederikshavn $^{10}/_{5}$ 1929.	29.0(3)	28.5(2)	38.1(91)	39.3(103)	44.6(10)	49.8(8)	49.9(9)	49.8(19)	51.3(5)	53.5(2)	52.0(1)	78.0(2)	..	93.5(2)
Aabenraa Fjord $^{9}/_{5}$ 1929...	..	..	36.3(12)	36.0(10)	41.0(1)	44.5(3)	47.3(36)	48.1(31)	52.8(6)	55.0(3)	..	..	..	..
Rønne Bank $^{12}/_{5}$ 1929	..	..	34.0(1)	34.5(6)	42.5(2)	42.7(14)	49.2(14)	51.0(34)	67.0(2)	64.2(5)	62.0(1)	67.0(1)	..	..
WNW. of Masnedsund $^{11}/_{1}$ 1929	35.0(1)	36.0(1)	44.0(3)	41.7(3)	45.2(24)	45.7(25)	..	48.0(2)	..	..	..	..	..	83.0(1)
Adlergrund $^{31}/_{1}$ 1929.....	31.0(1)	30.0(1)	35.7(16)	36.3(24)	40.8(13)	42.1(22)	45.4(7)	44.0(5)	45.0(2)	..	..	..	..	..
Livø Bredning $^{10}/_{9}$ 1929 ...	31.8(49)	33.2(51)	..	..	..	..	..	..	..	..	..	..	..	..
Off Thyborøn $^{31}/_{10}$ 1929 ...	27.6(50)	28.0(61)	..	..	..	..	..	..	..	..	..	..	..	..
Off Thyborøn $^{21-22}/_{9}$ 1905 ..	23.9(394)	24.2(355)	..	..	..	..	..	..	..	..	..	..	..	..
N. of Læsø $^{1}/_{5}$ 1926	..	..	34.1(9)	34.0(15)	..	..	..	..	..	..	..	..	..	..
South Little Belt $^{8-10}/_{5}$ 1926	19.3(15)	20.1(7)	24.2(9)	23.8(6)	34.9(33)	36.5(17)	..	..	..	..	..	..	..	..
Southern Belt Sea $^{10-13}/_{6}$ 1928	..	..	..	..	35.8(76)	36.3(61)	..	..	..	..	..	..	..	..
Western Baltic $^{26}/_{7}$ 1928 ...	..	..	..	..	37.9(20)	39.3(27)	..	..	..	..	..	..	..	..
Southern Belt Sea $^{28}/_{7}$ 1928	..	..	35.2(10)	36.0(7)	41.3(55)	42.4(38)	..	..	..	..	..	..	..	..
At Schultz' Grund $^{28-29}/_{9}$ 1913	..	..	30.9(64)	31.7(51)	40.8(43)	41.1(56)	46.8(58)	48.3(56)	52.7(85)	56.0(77)	57.9(21)	58.1(27)	65.5(4)	66.6(8)

the Kattegat large cod can be caught, weighing up to 40 Pd. (20 kg) and more, being also fairly numerous at certain times and places."

G. Winther, H. I. Hansen, and Ad. S. Jensen (1878—1907) write: "In the Sound and the Belts the older cod attain on an average a length of $2^{2}/_{3}$—3 ft. (70—90 cm.). Cod averaging $3^{1}/_{3}$—4 ft. have however been caught here but only on rare occasions." In the North Sea off Harboøre a cod was caught which, C. V. Otterstrøm reports, weighed the respectable amount of 25.5 kg.

4. The Age and Size of the Cod upon attaining Sexual Maturity.

Table 18 shows the number of immature and mature males and females of different age- and size groups. We will first consider the distribution as to age between the immature and mature cod.

The material concerning age upon attaining sexual maturity for the first time is drawn together in the following summary, where the percentages of the mature cod of the different ages are stated:

	North Sea, Skagerak and northernmost Kattegat				Southern Kattegat and Belt Sea				Baltic proper east and south of Bornholm			
	♂		♀		♂		♀		♂		♀	
Year	Number investigated	% mature	Number investigated	% mature	Number investigated	% mature	Number investigated	% mature	Number investigated	% mature	Number investigated	% mature
1	13	0	8	0	20	0	10	0	..	..	..	..
2	151	2	151	1	84	15	88	15	5	100	6	17
3	40	28	29	10	158	28	124	23	8	87	14	64
4	17	76	30	53	154	66	115	70	17	88	33	70
5	8	100	3	100	20	80	13	85	3	100	5	100
6	4	100	10	100	3	100	8	100	1	100	1	100
7	..	..	2	100	6	100	1	100	..	..	..	..
8	1	100	..	..	1	100	1	100	..	..	..	..
Total number	234	..	233	..	446	..	360	..	34	..	59	..

Table 18. Length and Age of immature and mature

Locality and Date	North Sea and Skagerak the months Nov.—May of various years								Off Frederikshavn 10. May 1929							
	♂				♀				♂				♀			
	imm.		m.		imm.		m.		imm.		m.		imm.		m.	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	
Length-group																
11—20 cm.	5	100	..	..	4	100	..	..	..	..	..	..	..	..	..	
21—30 -	38	100	..	..	55	100	..	..	4	100	..	..	5	100	..	
31—40 -	37	93	3	7	72	100	..	..	64	96	3	4	63	100	..	
41—50 -	24	77	7	23	39	100	..	..	31	82	7	18	43	80	11	
51—60 -	16	67	8	33	2	67	1	33	..	..	8	100	4	40	6	
61—70 -	9	60	6	40	5	42	7	58	..	..	..	..	..	..	1	1
71—80 -	..	..	11	100	4	25	12	75	..	..	..	..	1	33	2	
>80 -	..	..	7	100	..	..	11	100	..	..	..	..	..	..	2	1
Total number...	129	..	42	..	181	..	31	..	99	..	18	..	116	..	22	
Age																
1 year	10	100	..	..	6	100	..	..	3	100	..	..	2	100	..	
2 —	59	98	1	2	48	100	..	..	89	98	2	2	102	99	1	
3 —	22	70	8	30	19	90	2	10	7	70	3	30	7	87	1	
4 —	4	..	4	100	9	82	2	18	..	..	9	100	5	26	14	
5 —	..	..	5	100	..	..	1	100	..	..	3	100	..	..	2	1
6 —	..	..	3	100	..	..	8	100	..	..	1	100	..	..	2	1
7 —	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1
8 —	..	..	1	100	..	..	..	..	..	..	..	..	..	..	..	
Total number...	95	..	22	..	82	..	13	..	99	..	18	..	116	..	22	

Locality and Date.....	Langelands Belt 6. April—24. June 1909								East and North of Als May 1926							
	♂				♀				♂				♀			
	imm.		m.		imm.		m.		imm.		m.		imm.		m.	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	
Length-group																
11—20 cm.	2	100	..	..	2	100	..	..	16	100	..	..	6	100	..	
21—30 -	61	90	7	10	48	79	13	21	11	69	5	31	8	100	..	
31—40 -	66	52	61	48	38	50	38	50	11	55	9	45	12	86	2	1
41—50 -	9	29	22	71	4	27	11	73	4	67	2	33	2	100	..	
51—60 -	1	20	4	80	1	100	..	..	..	..	..	..	..	..	..	
61—70 -	..	..	1	100	..	..	..	..	..	..	..	..	..	..	..	
71—80 -	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
81—90 -	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Total number...	139	..	95	..	93	..	62	..	42	..	16	..	28	..	2	
Age																
1 year	2	100	..	..	2	100	..	..	15	100	..	..	7	100	..	
2 —	23	96	1	4	16	57	12	43	5	56	4	44	6	100	..	
3 —	72	73	27	27	54	71	22	29	22	67	11	33	15	88	2	1
4 —	27	40	40	60	14	44	18	56	..	..	1	100	..	..	..	
5 —	2	29	5	71	2	25	6	75	..	..	..	..	..	..	..	
6 —	..	..	1	100	..	..	3	100	..	..	..	..	..	..	..	
7 —	..	..	5	100	..	..	..	..	..	..	..	..	..	..	..	
8 —	..	..	1	100	..	..	..	..	..	..	..	..	..	..	..	
Total number...	126	..	80	..	88	..	61	..	42	..	16	..	28	..	2	

It appears that in the North Sea, Skagerak and northernmost part of the Kattegat (north of Læsø) only very few cod become mature at an age of two years, with 3 years age c. 1/4 of the males and 1/10 of the females are mature, with 4 years 3/4 of the males and 1/2 of the females; the older fish examined

m different Localities in the Waters round Denmark.

Southern Kattegat, Feb.-May of various years								Kerteminde Bay 2. May 1929								Smaalandshavet 11. Jan. 1929							
♂				♀				♂				♀				♂				♀			
imm.		m.		imm.		m.		imm.		m.		imm.		m.		imm.		m.		imm.		m.	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
4	100	..	..	2	100	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7	53	15	47	36	84	7	16	7	100	..	..	13	100	..	..	..	..	..	..	..	..	..	..	..
7	43	23	57	33	59	23	41	10	83	2	17	7	78	2	22	4	100	..	..	2	40	3	60
3	50	13	50	9	39	14	61	8	38	13	62	4	22	14	78	3	14	19	86	10	45	12	55
1	25	3	75	2	50	2	50	..	..	10	100	2	25	6	75	2	100	..	..	..	..	4	100
.	..	4	100	..	..	1	100	..	..	..	..	..	..	1	100	..	..	..	..	..	..	..	..
.	..	1	100	..	..	1	100	..	..	..	..	..	..	1	100	..	..	..	..	..	..	..	..
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	100
2	..	59	..	82	..	48	..	25	..	25	..	26	..	24	..	9	..	19	..	12	..	20	..
3	100	..	..	1	100	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7	85	3	15	24	100	..	..	17	94	1	6	18	95	1	5	1	100	..	..	1	100	..	..
5	79	4	21	20	95	1	5	3	100	..	..	4	80	1	20	2	67	1	33	3	100	..	..
1	20	4	80	2	29	5	71	4	19	17	81	4	19	17	81	6	25	18	75	8	32	17	68
.	..	1	100	..	..	..	..	1	17	5	83	..	..	..	..	..	..	..	..	..	..	2	100
.	..	..	..	..	..	1	100	..	..	2	100	..	..	4	100	..	..	..	..	..	..	..	..
.	..	1	100	..	..	..	..	..	..	..	..	..	..	1	100	..	..	..	..	..	..	..	..
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	100
6	..	13	..	47	..	7	..	25	..	25	..	26	..	24	..	9	..	19	..	12	..	20	..

Aabenraa Fjord 9. May 1929								Rønne Bank 12. May 1929								True Baltic east and south of Bornholm 13.—21. June 1923							
♂				♀				♂				♀				♂				♀			
imm.		m.		imm.		m.		imm.		m.		imm.		m.		imm.		m.		imm.		m.	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	69	99	2	12	15	88
7	50	7	50	11	85	2	15	..	..	2	100	9	64	5	36	3	3	112	97	3	8	37	92
3	48	14	52	5	25	15	75	2	20	8	80	9	41	13	59	..	..	21	100	..	..	11	100
3	25	9	75	..	..	10	100	1	25	3	75	2	17	10	83	1	14	6	86	..	..	2	100
.	..	2	100	..	..	2	100	..	..	4	100	..	..	8	100	..	..	7	100	..	..	14	100
.	..	..	..	..	..	..	..	..	..	..	..	..	..	3	100	..	..	14	100	..	..	26	100
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	100	..	..	4	100
3	..	32	..	16	..	29	..	3	..	17	..	20	..	39	..	5	..	230	..	5	..	109	..
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	67	4	33	10	100	..	..	..	..	1	100	5	83	1	17	..	..	4	100	..	..	..	..
.	..	1	100	..	..	2	100	1	50	1	50	5	36	9	64	..	..	6	100	..	..	..	..
4	39	22	61	6	20	24	80	2	14	12	86	10	30	23	70	..	..	3	100	..	..	..	..
1	17	5	83	..	..	3	100	..	..	2	100	..	..	5	100	..	..	1	100	..	..	..	..
.	..	..	..	..	..	..	..	..	..	1	100	..	..	1	100	..	..	..	..	..	..	..	..
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	..	32	..	16	..	29	..	3	..	17	..	20	..	39	..	..	..	14	..	..	..	..	..

were all mature. In the southern Kattegat and the Belt Sea maturity is reached with a little lower age: with 2 years c. 1/7 of both sexes are mature, with 3 years little more than 1/4 of the males and little less than 1/4 of the females are mature: with 4 years c. 2/3 of both sexes have reached maturity and with

5 years c. 4/5. In the Bornholm waters maturity is reached at a somewhat lower age; the material is rather small, but it indicates that a large part of the males and a small part of the females already become mature at an age of 2 years, of the 3 and 4 years old fish the great majority both of the males and females are mature, and all the 5 years old are mature. The average age upon attaining sexual maturity is on a whole a little lower for the males than for the females.

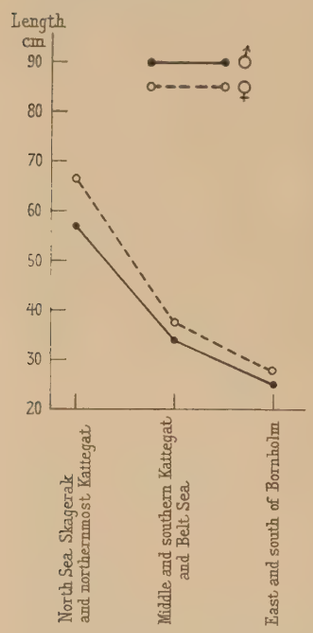

Fig. 30. Average size upon first Maturity of males and females in different Danish waters.

The average size upon first maturity (after KYLE, 1900, defined as the size at which equal numbers are immature and mature) in the above named areas is shown in Fig. 30. The curves are made on the basis of the material put down in Tab. 18, but before the drawing together of the single measurements by the cm. in length groups. The average size upon first maturity is in the North Sea, the Skagerak and northernmost Kattegat for the males c. 57 cms. and for the females c. 66 cm. In the southern Kattegat and the Belt Sea the average size is lower, for the males c. 34 and for the females c. 38 cms. In the Bornholm water it is still lower, for the males c. 25 and for the females c. 28 cms. It appears that the average size upon first maturity is a little lower for the males than for the females.

VII. The Food of the Cod.

For the understanding of several aspects in the biology of a species of fish it is of great importance to have some knowledge of its food.

The migrations undertaken by the fish are often directly determined by the search for food; this is the case for instance with the migrations of the North Sea Bank Herring into the Skagerak in late autumn and winter and with the wellknown summer migrations of the mackerel into our waters. The young cod in the north-eastern Atlantic undertake extensive migrations (JOH. HJORT 1914, p. 113) in order to follow the capelan, which is one of the most important elements in their food.

The nature of the food plays a great part, naturally enough, as regards rate of growth. It has been shown for instance (ERIK M. POULSEN, 1928) that the haddock grows far more rapidly in the Belt Sea and Western Baltic, where it lives chiefly on molluscs, than in the North Sea where its most important food is the echinoderms, which are of little food value.

Finally the greater or lesser amount of food available may exert an influence on the density of the different fish stocks in the area in question. If one or several species of fish, living to a considerable extent on the same food animals, inhabit one area a great increase or decrease in the stock of a species will produce worse or better conditions respectively for it or the other fish which live on the same food; considerable fluctuations may then arise in the density of the stock and the growth of the individuals, fluctuations which we shall be quite at a loss to understand unless we have some knowledge of the food animals on which the species of fish in question feed.

The food of the cod in our home waters has been investigated by H. BLEGVAD (1916); he writes (p. 58) on the nature of the food as ascertained from the stomach analyses of 912 cod from our inner waters:

"The cod feeds principally on fish, crustaceans, and echinoderms; in the plant zone and along the coasts where it spends its first years of life it subsists mainly on crabs and smaller crustaceans, also, and especially in the adult, migratory stage on the small fish of the plant region." In the deeper water BLEGVAD found that the ophiuroids played an important part, and he also found among the contents of the stomachs "a quantity of crustaceans, some worms, especially *Trophonia plumosa*, a number of flatfish and the large gastropods *Neptunea antiqua* and *Buccinum undatum*." At intermediate depths fish and

crustaceans constitute the chief food; a number of worms are also consumed especially *Nephthys* and *Aphrodite;* "only one class of animals rarely tempts the cod, to wit, bivalves." "In the Baltic the chief food is *Idothea* and *Mysidæ.*"

R. A. Todd (1907) carried out in 1904—1905 fairly comprehensive stomach analyses of cod from the North Sea (examining in all 402 individuals). He arrived at the conclusion that the quite small cod (< 15 cm.) live mainly on crustaceans (*Copopods, Mysids),* the somewhat larger (15—30 cm.) also on crustaceans *(Crangon, Eupagurus, Portunus)* and to a lesser extent on fish and annelids. Cod between 30 and 60 cm. in length live chiefly on fish and crustaceans, to a lesser degree on molluscs, while the large cod of over 60 cm. live mostly on fish (sandeel, whiting, dabs, and to a lesser extent herring); of somewhat less importance as food are the crustaceans and of still less importance the annelids (mainly *Aphrodite aculeata).*

These investigations will be supplemented in the following with a series of stomach analyses of cod from the North Sea and Skagerak, the inner Danish waters, and the Baltic around Bornholm. The material for these analyses is derived partly from cod caught with the trawl from "Dana" or with the tog from the "Japetus Steenstrup", and partly from cod purchased from various fishing ports in the winter and spring of 1929 and examined in the laboratory at Hellerup.

In Table 19 are given the results of the stomach analyses of cod caught with the trawl in 1922—1926 and with the tog in 1928. The method employed in the investigations has been to report the number of stomachs in which each food animal has been found. In the Table are entered 659 cod with stomach contents. It appears from the Table that the food of the cod is extremely varied, which is natural enough seeing that cod occur so to say at all depths from the coastal water out to a depth of c. 400 metres. One has the impression almost that the cod eats everything edible it encounters on its way, both bottom animals and planktonic forms, but for by far the most part bottom animals or animals which live just above the bottom.

The smaller cod less than 15 cm. in length, chiefly the 0-Group, live mainly on *Copepods, Mysids, Gammarids,* and *Polychaets.* In a single sample of cod of this size group from the North Sea large numbers of herring larvae were found. The smallest individuals of the 0-Group live chiefly on *Copepods* and young *Mysids;* it is only among the somewhat larger individuals of the 0-Group that worms are found at all frequently in the stomachs.

Among the somewhat larger cod between 15 cm. and 30 cm. (chiefly the I-Group) the bottom animals completely predominate in the stomachs. Thus in the case of this size group there are commonly found: various polychæts *(Nepthys, Terebellides),* crustaceans (*Gammarids, Idotea, Crangon,* and young *Portunus).* Of fish there are frequently found cod and whiting of the 0-Group, dabs and herring being less frequent.

In the stomachs of the medium cod (30—50 cm.) the fish most often found are the herring, goby, and lumpenus, the most frequent invertebrates being: *Cumacea, Nephthys, Pectinaria, Crangon* (both *vulgaris* and *allmanni*), *Abra alba, Gammarids,* and *Mysids.* In the Baltic Proper *Chiridotea entomon* is often found in the stomachs.[1]

In the stomachs of the large cod (above 50 cm.) are found chiefly fish (dabs, whiting, herring, lumpenus, cod), the larger decapods (*Portunus, Carcinus, Eupagurus bernhardus*), gastropods *(Buccinum*), and *Ophiura.* Somewhat less frequent are the dragonet, plaice, rockling, sprat, glass eel, and shrimp. In the stomachs of large cod from the deeper parts of the Skagerak are found: *Pandalus borealis, Geryon tridens, Munida tenuimana, Pontophilus norvegicus, Gadus esmarki,* and small *Chimaera montrosa.* At inter-

[1] In another connexion it is of interest to note that in the stomach of a cod caught in August on Adler Grund a young sea-trout, 6 cm. in length, was found. This shows that the sea-trout in the brackish parts of the Baltic make their way out to sea when they are a few months old. Fishermen from Bornholm have also observed young sea-trout a few centimetres in length in the quite shallow water along the coast.

Table 19. Content of Stomachs of Cod caught in Ottertrawl and Tog. (The numbers indicate in how many stomachs the said food-animal is found).

	North Sea, Skagerak and Kattegat				Belt Sea and Western Baltic				Baltic proper			
Length in cm. of the cod investigated	< 15	15—30	31—50	> 50	< 15	15—30	31—50	> 50	< 15	15—30	31—50	> 50
Agonus cataphractus	..	1	..	..	..	..	..	..	..	..	..	..
Cottus sp.	..	..	..	..	..	..	1	..	..	..	..	..
Spinachia vulgaris	..	..	..	..	..	..	1	..	..	..	..	..
Lumpenus lampetriformis	..	..	..	..	..	..	4	10	..	1	2	..
Centronotus gunellus	..	..	..	..	..	..	..	1	..	..	1	..
Gobius sp.	..	1	..	1	..	7	6	..	..	1	4	..
Aphya pellucida	..	..	..	..	..	1	..	..	..	..	..	..
Callionymus sp.	..	..	1	4	..	..	..	..	..	..	..	..
Gadus callarias	..	..	..	3	..	14	2	6	..	..	1	..
— merlangus	..	..	..	20	..	41	..	4	..	..	..	..
— esmarki	..	..	..	2	..	..	..	..	..	..	..	..
Onos sp.	..	..	..	2	..	..	..	1	..	..	..	..
Zoarces viviparus	..	..	..	..	..	..	1	..	..	..	..	..
Ammodytes sp.	..	..	..	1	..	2	..	..	..	..	2	..
Pleuronectes platessa	..	..	..	1	..	..	1	1	..	..	..	..
— flesus	..	..	..	..	..	..	..	1	..	..	..	..
— limanda	..	1	..	11	..	2	2	7	..	1	3	..
Drepanopsetta platessoides	..	..	..	1	..	..	1	1	..	..	..	..
Pleuronectes sp.	..	..	..	..	..	..	..	3	..	..	..	..
Salmo trutta	..	..	..	..	..	..	..	..	..	..	1	..
Clupea harengus	..	2	..	11	..	1	18	..	..	1	5	..
— sprattus	..	..	..	2	..	..	..	..	..	..	..	..
Anguilla vulgaris	..	..	..	2	..	..	..	..	..	..	..	..
Larvae of herring	14	..	..	..	..	..	..	..	..	..	..	..
Roe of Cyclopterus lumpus	..	..	..	..	..	..	1	..	..	..	..	..
Chimaera monstrosa	..	..	..	1	..	..	..	..	..	..	..	..
Remains of fish	..	2	..	1	..	3	6	..	..	..	2	..
	14	7	1	63	..	71	44	35	..	4	21	..
Loligo sp.	..	..	..	1	..	..	..	..	..	..	..	..
Cyprina islandica	..	..	..	..	..	..	..	1	..	..	..	..
Macoma calcarea	..	..	..	..	..	..	..	..	..	..	1	..
Tellina baltica	..	..	..	..	..	..	..	..	..	..	2	1
Abra alba	..	..	..	..	..	..	31	1	..	..	..	..
Mactra sp.	..	1	..	..	..	..	..	..	..	..	..	..
Mya arenaria	..	..	..	..	..	2	3	1	..	..	..	..
Mytilus edulis	..	..	..	..	..	..	2	1	..	..	4	..
Natica sp.	..	1	..	..	..	..	..	..	..	..	..	..
Fusus antiquus	..	..	..	..	..	..	5	1	..	..	..	..
Buccinum undatum	..	..	..	6	..	1	2	2	..	..	..	..
Bela sp.	..	..	..	..	..	..	1	..	..	..	..	..
Acera bullata	..	..	..	..	..	..	1	..	..	..	..	..
Philine aperta	..	..	..	..	..	..	5	1	..	..	..	..
	..	2	..	7	..	3	50	8	..	..	7	1

mediate depths in the North Sea, Skagerak, and Kattegat *Nephrops norvegicus* are commonly found in the stomachs.

In order to throw further light on the food of the cod in our waters a series of analyses are given in Table 20 of cod caught in commercial fishing operations.

The stomach analyses of cod caught in pound-nets (Aabenraa Fjord May 9th, 1929 and Frederiks-

Table 19 (continued).

Length in cm. of the cod investigated	North Sea, Skagerak and Kattegat				Belt Sea and Western Baltic				Baltic proper			
	< 15	15—30	31—50	> 50	< 15	15—30	31—50	> 50	< 15	15—30	31—50	> 55
Copepoda	..	..	..	..	5	1	..	..	..	..	..	..
Cumacea	..	..	..	..	1	20	82	2	..	..	8	2
Idotea sp.	..	..	..	..	..	4	11	..	..	2	2	..
Chiridotea entomon	..	..	..	..	..	..	..	..	..	..	5	..
Gammaridae	4	..	..	..	6	5	19	..	..	7	11	5
Corophium	..	11	..	..	..	..	..	..	..	..	..	.
Mysidae	..	..	..	..	16	9	13	3	22	6	30	2
Portunus sp.	..	8	..	22	..	..	..	..	..	..	..	..
Carcinus maenas	..	..	..	1	..	5	4	12	..	..	..	3
Cancer pagurus	..	..	..	2	..	..	..	..	..	..	.	..
Geryon tridens	..	..	..	2	..	..	..	..	..	..	..	..
Inachus sp.	..	..	..	1	..	..	..	..	..	..	..	..
Hyas sp.	..	..	..	2	..	..	1	..	..	..	..	..
Nephrops norvegicus	..	..	1	11	..	..	..	..	..	..	..	..
Munida tenuimana	..	..	..	1	..	..	..	..	..	..	..	..
Eupagurus bernhardus	..	7	2	12	..	7	9	6	..	..	..	..
Pontophilus norvegicus	..	..	..	1	..	..	..	..	..	..	..	..
Crangon sp.	..	7	..	7	6	13	30	5	4	2	6	3
Pandalus sp.	..	..	..	10	..	..	..	..	..	..	..	..
Palæmon sp.	..	..	..	..	..	..	1	..	..	..	..	..
	4	33	3	72	34	64	170	28	26	17	62	15
Arenicola marina	..	..	..	..	..	..	8	2	..	..	..	..
Nephthys sp.	..	..	..	..	6	14	50	5	..	..	1	1
Terebellides sp.	..	..	..	..	1	2	6	..	..	..	2	1
Nereis sp.	..	..	..	..	2	..	..	..	..	..	..	..
Pectinaria sp.	..	..	..	..	..	1	32	1	..	..	..	..
Harmothoe sp.	..	..	..	..	..	1	..	..	..	..	2	..
Aphrodite aculeata	..	..	1	6	..	..	1	1	..	..	..	..
Polychæta indet.	2	2	..	..	..	3	7	..	..	..	..	..
	2	2	1	6	9	21	104	9	..	..	5	2
Gephyrei	..	..	..	1	..	..	1	..	..	..	1	..
Ophiuridea	..	..	..	24	1	..	7	4	..	..	..	..
Echinus sp.	..	..	..	2	..	..	..	1	..	..	..	..
Holothurioidea	..	..	..	..	..	2	1	1	..	..	..	..
Nemertini	..	..	..	..	..	..	..	..	..	..	3	..
Pleurobrachia	..	..	..	1	..	..	..	1	..	..	..	..
No. of cod with stomach-content	16	22	4	100	43	116	201	46	25	18	58	10

havn May 10th, 1929) do not give us a completely reliable picture of what the cod live on, since part of what is found in the stomachs may have been eaten after the cod have entered the pound-nets. The sample from Aabenraa is particularly conspicuous in this respect on account of herring being so extremely frequent in the stomachs. It was in this very month, May 1929, that a fishing for herring on a large scale took place in Aabenraa Fjord (and adjacent waters) both with pound-nets and seines. Many of the herring observed in the stomachs of the cod were so fresh that one must assume that the cod ate them while in the pound-nets, but some of them were digested to such an extent that one must assume that they had been eaten before the cod had entered the pound-nets. It is obvious that the cod

Table 20. Content of Stomachs of Cod caught by Fishermen in 1929. (The numbers indicate in how many stomachs the said food-animal is found).

Locality and Date	Off Thyborøn 31. Oct. 1929		Off Frederikshavn 10. May 1929			Livø Broad 10. Sept. 1929		Kerteminde Bay 2. May 1929			Smaalands-havet 11. Jan. 1929		Aabenraa Fjord 9.May 1929		Adler Grund 31. Jan. 1929
Length in cm. of the cod investigated	23—30	31—37	26—30	31—50	51—99	27—30	31—41	26—30	31—50	51—73	35—50	51—83	32—50	51—83	31—50
Gasterosteus aculeatus	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
Spinachia vulgaris	..	..	..	..	..	..	..	..	1	1	1	..	..	..	..
Lumpenus lampetriformis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Gobius sp.	13	4	..	..	..	1	1	..	..	..	4	1	..	..	1
Belone vulgaris	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..
Gadus callarias	..	..	..	3	6	..	1	..	6	2	1	1	..	..	1
— merlangus	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..
Pleuronectes platessa	..	..	..	8	5	..	..	..	..	..	..	..	..	..	..
— sp.	..	..	..	6	1	..	..	..	..	..	..	..	..	..	..
Clupea harengus	..	..	..	11	4	2	5	..	5	2	4	2	46	18	..
— sprattus	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
— sp.	..	..	..	..	..	9	32	..	..	..	..	..	..	..	..
Anguilla vulgaris	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..
Roe of Cyclopterus lumpus	..	..	..	2	5	..	1	1	..	..	..	..	..	..	..
Remains of fish	2	..	..	5	3	..	7	..	3	..	1	1	3	..	1
Mytilus edulis	..	..	..	..	..	..	1	..	..	..	..	..	..	..	3
Trochus cinerarius	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Natica	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Buccinum undatum	..	..	..	..	..	..	3	..	..	..	..	..	1	..	..
Cumacea	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Idotea sp.	..	..	1	19	2	..	..	1	..	..	..	..	..	..	..
Chiridotea entomon	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5
Gammaridae	..	..	..	6	..	..	..	..	..	..	3	..	1	..	4
Mysidae	3	..	..	..	..	..	1	..	..	..	4	..	..	..	1
Portunus holsatus	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Carcinus maenas	14	3	..	16	9	1	5	..	7	9	1	..	1	6	..
Cancer pagurus	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
Eupagurus bernhardus	36	10	..	9	5	..	..	..	..	..	..	1	..	..	..
Crangon vulgaris	56	10	1	6	..	2	10	1	1	..	6	2	..	..	..
Arenicola marina	2	..	2	48	6	..	..	..	..	..	..	..	..	..	..
Aphrodite aculeata	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..
Pectinaria sp.	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Nereis sp.	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polychaeta indet.	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
Cucumaria sp.	..	..	..	2	..	..	..	..	1	..	..	..	..	..	..
Ophiuridea	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..
See-weed	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..
Stone	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Empty	3	..	4	100	3	6	24	17	36	11	35	1	35	7	78
No. of individuals investigated	94	17	9	222	24	19	81	20	60	20	53	17	75	26	94

like to eat herring, and in places where there are dense aggregations of herring they form a very considerable part of the food of the local cod stock.

Stomach analyses of cod caught in pound-nets off Frederikshavn present a somewhat different picture. The herring are here not nearly as numerous as in the Aabenraa sample. Plaice are just as frequent in the stomachs as herring, in fact perhaps even more frequent; many of the plaice observed were digested to such an extent that it must be assumed that the cod ate them before entering the pound-nets.

The coastal waters of the western Kattegat contain as is well-known, a comparatively dense stock of young plaice. The many plaice in the stomachs of cod caught in the pound-nets off Frederikshavn show that plaice here constitute a considerable part of the food of the cod. That it is by no means small numbers of plaice that a cod can consume is shown by the following extract from analyses of cod caught in pound-nets off Frederikshavn:

1 cod,	79 cm.,	in stomach:	10	plaice	from c. 15 to c. 22 cm.
1 —,	88 —,	— :	11	—	— - 15 - - 22 —
1 —,	73 —,	— :	5	—	c. 20 cm.
1 —,	40 —,	— :	2	—	8 and 10 cm.
1 —,	99 —,	— :	5	—	up to 24 cm.
1 —,	77 —,	— :	6	—	— 22 —

The cod found in the stomachs of cod from Frederikshavn all belonged to the I-Group. The herring in the stomachs were 20—25 cm. in length. The few garfish found were only slightly digested; they had probably been eaten in the pound-nets and were between 60 cm. and 68 cm. in length. Of especial interest is the large number of *Arenicola* found in the stomachs, the latter often being quite full of these worms. The common shore crab was frequent in the stomachs, especially among the medium cod.

Analyses from Bornholm show that *Chiridotea entonom* forms here a not inconsiderable constituent of the food of cod. Farther towards the east in the Baltic the importance of *Chiridotea* as food is very great (Hessle 1923). As regards the Danzig Deep, H. Hertling (1928, p. 119) writes: "Ein ganz besonders wichtiges Nährtier [for the somewhat larger cod] im Danziger Tief ist *Chiridothea*."

Species of fish, crustaceans, and annelids form the chief constituents of the food of cod. Annelids (mainly *Polychaets*) and the smaller crustaceans constitute the bulk of the food of small cod, and fish and the larger crustaceans the bulk of the food of the larger cod. It is noteworthy that molluscs are not very important as food. In only one sample from the Belt Sea have large numbers of *Abra alba* been found in the stomachs. The smaller molluscs are eaten whole, including the shell, but of the larger *Buccinum* and *Fusus* shells are never found in the stomachs, although shell-lids and feet are found. No shells of the large Mya but bitten-off siphons are found. Of *Cardium echinatum* 2 feet were found in the stomach of a cod from the Kattegat, but no traces of shell.

As is clear from the analyses quoted here, the food of the cod is of a very composite nature, so that one finds widely differing kinds of food in the stomachs of cod in the same stock. As a consequence of this greatly varying food, the cod in many different respects influence the economy of the sea, and this influence is of importance owing to the large numbers of cod in practically all our waters. Aage J. C. Jensen has thus (1929) by means of statistical data relating to fishery shown the probability of the cod stock in our inner waters attacking the herring stock to a noticeable extent.

VIII. Fluctuations in the Age Composition of the Cod Stock in the Course of Years.

It has been shown that the numerical abundance of various species of fish changes from year to year or from one period of years to another. Such changes have been shown to exist both by fishery statistics and scientific fishing experiments. That these fluctuations have been proved to take place from year to year is of interest not only in connexion with the fishery but also from a purely scientific standpoint; by comparing them with fluctuations in hydrographic conditions we can obtain information as to the biology of the fish in question.

The investigations carried out by HENKING (1905), A. C. JOHANSEN (1908 and 1927), and JOH. HJORT (1914) on the fluctuations in numbers among various species are examples of how knowledge of these fluctuations can be used for throwing light on the yield of the fisheries in future.

The cod stock in Danish waters undergoes, as will be shown in the following, great fluctuations. In order to make the utmost use of these fluctuations towards advancing our understanding of various problems in the biology of the cod, I have sought to collect material for the purpose of throwing light on the fluctuations in numbers not only in the cod stock taken as a whole but also within the different stages of the cod's life: larval stage, 0-Gr., I-Gr. etc.

1. Fluctuations in the Number of Larvae from Year to Year.

An account of the nature and extent of the material utilized here has been given in a preceding section (V). We will first consider the consecutive series of investigations from 1923 to 1929.

The widely differing hydrographical conditions in the Danish waters render it necessary to deal with each area separately when an account is to be given of the fluctuations in the number of fry; the best and most copious data relating to the fluctuations have been obtained from the Belt Sea and Kattegat, and these two areas will consequently be especially considered in the following.

The results of the investigations on the frequency of the fry in all areas are given in Table 11 for each month of the different years (p. 39). The figures in the Table denote the average catch with ring trawl per half hour of all the hauls in the area and month in question, regardless of whether the hauls were made in the upper or lower water layers. Hauls made outside the 100 metre line are not included. We are justified in disregarding in this Table which water layer the haul was made in, since in the vast majority of cases when hauls have been made in the deeper water layers catches have also been made in the upper layers or "step hauls" have been made (see below). Besides each average number is given the number of hauls for the month in the area in question.

On the Charts, Figs. 15—19 and 21—25, are given the numbers of cod larvae caught at the various stations. In nearly every case the duration of the hauls has been half an hour; where this has not been so the number of larvae found has been converted so as to correspond to a duration of half an hour. All the figures on the Charts thus refer to the numbers of cod larvae taken in half an hour. As regards stations outside the 12 metre line it is stated whether the hauls were made in the upper or lower water layers, numbers above a line denoting hauls made in the upper layers from 0 m. down to c. 12 m., and those under a line denoting hauls from c. 12 m. downwards. At most of the stations outside the 12 metre line hauls were made, as appears from the Charts, both in the upper and lower water layers. In 1928 and 1929 a somewhat different fishing method has been adopted in the great majority of cases outside the 15 metre line in that step hauls have been made: i. e. at stations of less depth than 15 metres hauls have been made for 30 minutes at depths of c. 3—10 metres; at stations of between 15 and 30 metres' depth a haul has first been made for 15 minutes in the lower water layer and then so much wire has

been hauled in that the ring trawl has risen up into the upper water layer as far as a depth of c. 5 m., where a haul has been made for the same period. At stations of more than 30 metres' depth hauls have been made in the upper, intermediate, and lower water layers in all for 30 minutes. As regards the stations where the step hauls have been made only one figure can thus be given on the Chart since the larvae from the different depths are all mixed together during fishing.

If we consider the Charts showing the occurrence of the larvae, Figs. 15—19 and 21—25, we see clearly that the numbers of fry observed in the different years vary greatly. This may be seen roughly by taking the mean number of larvae per station for all areas together for each of the different years. This will however only give a concise but not very accurate picture, partly because fishing may be carried on in waters where cod are particularly numerous with greater intensity in certain years than in others, and partly because fishing operations are not always carried on each year at the same time. In order to remedy to some extent this latter discrepancy I have only included April and May in this summary, the two months in which by far the greatest number of stations are taken and in which the cod larvae in most of our waters occur in the greatest number. The calculation gives the following average number of larvae per half hour in the different years:

Year	1923	1924	1925	1926	1927	1928	1929	Average
No. of cod larvae per ½ hour	63	2	48	7	52	25	42	34

The years 1923, 1925, and 1927 must thus be regarded as especially good survival years for fry, 1924 and 1926 as very bad, 1928 as somewhat below normal, and 1929 as somewhat above normal.

If we now consider the Kattegat and Belt Sea separately, the two areas which have been most thoroughly investigated, we obtain a more accurate picture of the fluctuations.

In the case of the Kattegat we possess investigations in April in the years 1923—1927 and in 1929, but in 1928 only in June. However between the spawning season and June so much time has elapsed that one cannot compare the results from this month in one year with the results from April in another; we must therefore content ourselves in the case of the Kattegat with considering the years 1923—1927 and 1929. We thus obtain the following average catches per half hour for April in each of these years. The figures in brackets denote the numbers of hauls.

Kattegat

Year	1923	1924	1925	1926	1927	1928	1929	Average
No. of cod larvae per ½ hour in April	30 (34)	2 (5)	46 (29)	5 (19)	6 (3)	(0)	39 (10)	22

1923, 1925, and 1929 prove to have been good survival years for fry in this area; 1924 and 1926 were bad; 1927 seems also fairly bad, but as only 3 stations were taken in this year the figure given may be considered as uncertain and needs confirmation through the investigation of the numbers of the 0-Gr. in the summer of 1927 and of the I-Gr. in 1928 (about which more will be said later).

As regards the Belt Sea we possess investigations from April in 1923, 1924, 1925, 1927, and 1929, (but not from April 1926 and 1928), and from May in 1923, 1926, 1927, 1928, and 1929. In order to obtain a consecutive series of years, April and May are taken together. The inclusion of May in the calculations is justified in the case of this area inasmuch as the spawning season here, as mentioned on p. 27, takes place rather later than in the Kattegat. We thus obtain for the years 1923—1929 the following average catches per half hour in the Belt Sea:

Year	1923	1924	1925	1926	1927	1928	1929	Average
No. of cod larvae per ½ hour in April and May	140 (17)	2 (2)	67 (10)	5 (19)	63 (30)	25 (9)	41 (65)	46

The figures in brackets denote also here the numbers of hauls.

1923, 1925, and 1927 thus prove to have been good survival years for fry in this area, 1924 and 1926 to have been bad; 1928 must be regarded as somewhat under normal whilst 1929 approximates very nearly to normal. The years 1923—1926 thus give the same result, as regards the fluctuations in the numbers of fry, for the Belt Sea as for the Kattegat. In the Belt Sea, in contrast to the Kattegat, 1927 was a good year but we must take into consideration the fact that the figures for the Kattegat in 1927 are, as already mentioned, uncertain.

As regards the other areas, (see Table 11), the data are more scanty. In the case of the Sound however the figures for April show that 1923, 1925, and 1929 were considerably better survival years than 1926, which thus accords with the observations in the Kattegat and Belt Sea. Also in the Western Baltic 1925 and 1927 prove to have been good years for fry, while 1926 at any rate was bad. According to the investigations in April, 1927 seems to have been a particularly good year for the Western Baltic, better than both 1925 and 1923. In the Baltic proper the number of cod larvae observed was so small and the investigations so scanty that we cannot with any degree of certainty say anything about the fluctuations in the numbers of fry from year to year.

In the outer Danish waters of the Skagerak and North Sea, the investigations on larvae have not been carried out later than 1926. The observations from May 1923 and 1926 show clearly that 1923 was also here a more favourable year for cod fry than 1926. In 1923 in the Skagerak 104 larvae were taken on an average in half an hour in 8 hauls, whilst in 1926 in 19 hauls the average number of larvae taken was only 3. It is true that in April 1923 only 13 larvae were taken on an average in 15 hauls whilst in 1926 62 larvae were taken in 1 haul, but as in 1926 only this one haul was made in April it is undoubtedly best to use the observations from May when the investigations were far more comprehensive. The observations from April show that 1924 was a far worse survival year than 1925. In 1923—1926 the numbers of fry thus underwent the same fluctuations in the Skagerak and the north-eastern part of the North Sea as in our inner waters.

Altogether the investigations on the numbers of cod larvae in the years 1923—1929 show that 1923, 1925, and 1927 were favourable for the development of cod fry in our inner waters, whereas 1924 and 1926 were very unfavourable, 1928 being somewhat below normal and 1929 very nearly normal.

In the following will be given a summary of the investigations on fry in certain earlier years. No investigations in the number of larvae in Danish waters were carried out from 1914 till 1922. Prior to 1914 the investigations carried out from the "Thor" were rather scanty but we possess the results of fairly adequate investigations from several years, although no complete series of observations was carried out for a number of years such as was the case during the years 1923—1929. Only in 1904 and 1907 was a fairly large number of stations (33 and 28 respectively) taken in the Belt Sea and Kattegat in April and May; in 1905 2 stations were taken, in 1908 7 stations, in 1909 7 stations, in 1911 13 stations and in 1912 7 stations. The Petersen young fish trawl was used only at 1 of the 7 stations in 1909 whilst a ring trawl with a diameter of 1 metre was used at all the other stations. The results from this year are therefore rather unreliable and a comparison between the frequency of the larvae in this year and that in other years thus does not give a reliable result.

In order to obtain material which is to some extent consecutive, the observations from April and May are combined in the Table below, p. 75 (the figures in brackets beside the average number of larvae denote the numbers of hauls).

We see from this Table that 1904 was a rather bad survival year for cod fry in the Kattegat and Belt Sea. The investigations throw no light on the numbers of fry in 1905 and 1906. In 1907 the numbers of fry in the Kattegat were rather below normal. 1908 was a good year for fry in the Kattegat and Belt Sea. The results from 1909 seem to show that this year was bad for fry, but, as has been mentioned, a less effective fishing implement (the 1 metre ring trawl) was used in 1909, so the

	April + May							
	1904	1905	1906	1907	1908	1909	1911	1912
North Sea	..	6 (7)	9 (17)	168 (12)	..	..	..	
Skagerak	76 (2)	52 (2)	16 (2)	28 (5)	..	..	1.4 (7)	
Kattegat	4 (23)	1 (2)	..	23 (30)	110 (9)	6 (5)	4 (15)	0.5 (2)
Sound	..	..	..	0 (2)	9 (4)	..	..	.
Belt Sea	12 (26)	..	..	..	66 (2)	3 (8)	0.6 (7)	0.1 (7)
Western Baltic	..	..	..	..	41 (8)	..	0.2 (5)	0 (4)
Baltic proper	..	..	..	..	3 (30)			

results from this year must be accepted with reservations. 1911 and 1912 must be regarded as rather bad years for fry, but also in these two years the investigations were not very extensive and the results are therefore to some extent unreliable.

2. Fluctuations in the Frequency of the different Age Groups from Year to Year.

In the preceding section it has been shown how the numbers of cod larvae fluctuate from year to year in our different waters.

The stock of larvae which develops each year is of course the foundation for the future cod stock, and the larger the amount of larvae which develop in a given year the greater are the chances for a good fishing yield in the years when the year class in question is the object of fishing operations. But it is not only the number of larvae which determines the stock of the coming years since external conditions also affect the older stages of the cod, so that the effect of a good or bad survival year can be lessened. The larvae — both the younger and the older — are liable to be carried by the currents so that the number of larvae growing up in any given area can be diminished by some being carried away, or increased by others entering the area. Moreover the older larvae and the youngest bottom stage may be exposed to severe attacks by enemies. *Cyanea capillata* and *Pleurobrachia pileus*, in years when they appear in large quantities, can thus kill considerable numbers even of the larger larvae. Further young bottom stages of the 0- and I-Groups are eaten by rapacious fish, especially by the larger cod; in years when there is a large stock of older cod in our waters the 0- and I-Groups of cod may therefore be especially subject to attack. The conditions influencing the growth of the cod may also determine how important will be the part played by the various year classes in the fishery yield. If the food is scanty it is possible that some of the growing cod will emigrate to other areas; if this does not take place the growth rate will be so greatly diminished that a longer space of time than normal will elapse before the year class in question will attain such a size that it can be caught with fishing implements.

The question is therefore how great an influence on the numerical strength of the year classes is exerted by the conditions which the cod encounters during its last larval stage and later when growing up, and whether this influence is so great that it can wipe out the effect of a good or bad year for fry.

It may be recalled that since the years which have been good for fry in our inner waters have also proved to be good in the North Sea and Skagerak (see Section VIII, 1) there is no reason to assume that the effect of a good or bad year for fry in our inner waters will be diminished to any great extent by larvae being carried in from outside or by larger fish immigrating, since in the stocks to which these larvae and larger fish belong there is a similar proportion in numbers between the various year classes as in the stock which has developed in these inner waters.

The effect of a good or bad survival year may make itself felt for several years, which has been proved by earlier investigations on plaice, herring, and cod. We may therefore expect that a spring in which an especially large number of cod larvae have appeared will be followed by a summer in which very many

individuals of the 0-Group will be taken, and that in the next summer a large stock of the I-Group will be found, and so on. By investigating the frequency of the 0- and I-Groups and older age groups in different years we shall thus be enabled to check the observations made during the investigations on larvae, and if we find that the numbers of larvae in any given spring and of the 0-Gr. in the following summer and of the I-Gr. in the succeeding summer differ from the mean catch in the same direction and degree we obtain confirmation of the results obtained from the investigations on larvae. If, moreover, this is repeated for several years we find that the number of larvae in any year is an important factor in determining the numbers of the older age groups in later years, and that the conditions which influence the thriving of the larvae are more powerful in their effect than the natural conditions of the succeeding years which influence the growth of the various age groups.

To supplement the investigations on the number of larvae which have been described we will now in the folloving investigate the frequency of the 0- and I-Groups and the older age groups.

A series of age analyses of cod caught from the Danish Biological Station's steamer "Japetus Steenstrup" during the years 1919—1929 forms the bulk of the material for this investigation. The cod were caught with the tog. This implement and its efficacy has been described by A. C. Johansen (1928, p. 74): The tog is a fine-meshed otter trawl, i. e. a trawl devoid of arms but with lines between the trawl and the otter boards; the lower lines are provided with bass tassels. The meshes of the trawl are 18 mm. in front and 15 mm. behind from knot to knot. The trawl is provided with a chock. The tog is dragged in a towing bridle 40 metres in length at a speed of 1 knot. During the years 1926—1929 hauls of half an hour's duration were usually taken. A. C. Johansen has calculated that the area scoured in half an hour by the boards, bass lines, and foot rope of the trawl is c. 18,000 sq. metres, whilst the area scoured by the foot rope alone is c. 3,000 sq. metres. During the years prior to 1926 the hauls were as a rule of somewhat shorter duration, viz. 10—15—20 minutes. In the following however the catches are in every case calculated to correspond to hauls of 30 minutes.

As the implement is so fine-meshed it catches chiefly individuals of the younger year classes. As early as June—July many individuals of the year's fry are caught, down to a length of c. 5 cm.

Another and smaller part of the material was obtained from the trawling operations of the "Dana" in the years 1922—1927 in Danish waters. For this a 50 ft. otter trawl was used, with a larger mesh than that of the tog. The results obtained with these two implements can thus not directly be compared with each other. The otter trawl is as a rule provided with an extra codend, the meshes of which are so fine that even the bottom stages of the 0-Gr. are retained; as this codend only covers a small part of the trawl a comparatively large number of the smallest cod (0- and I-Groups) escape, but since this applies to all the fishing operations in which this implement is used the relative frequency of the 0-Gr. from year to year can nevertheless be determined.

Fishing operations with the otter trawl were carried out in the autumn of 1922 in the North Sea and Kattegat, in the spring and early summer of 1923 in the North Sea, Skagerak, Kattegat, the Western Baltic, and the Baltic proper, in the spring and autumn of 1925 in the Horn's Reef Area, in the spring of 1926 in the Skagerak, Kattegat, Belt Sea, and the Western Baltic, and in the spring of 1927 a few isolated hauls were made in the Horn's Reef Area.

From the years prior to 1914 we possess material obtained with the otter trawl from the "Thor": Sep., Oct. 1905 — the North Sea, Skagerak, and Kattegat; March, April 1906 — the North Sea, Skagerak, and Kattegat; Oct. 1906 — Kattegat; March, April, and May 1907 — all the Danish waters; June and July 1911 — the North Sea and Kattegat.

Finally some observations are included on the age distribution of cod caught on hooks and with the Danish seine.

The material obtained with the tog in the years 1919—1929 is entered in Table 21. In drawing up the latter only the hauls have been included in which cod have been taken which have been subjected

Table 21. Number of Cod of different Age Groups caugth per 30 minutes' hauls in Tog in different Waters in the Years 1919—1923 (Numbers in brackets indicate the total number of individuals of each age group caught in the hauls.

	Month	No. of stations	Duration of fishing minutes	Age group								
				0[1])	I	II	III	IV	V	VI	VII	VIII
	1919											
Kattegat	June	2	20	48(32)	9(6)	2(1)	..	..	..	..		
Belt Sea	Apr.-Sept.	36	506	55(835)	17(284)	10(172)	..	..	..	..	..	
	1920											
Isefjord	June	1	30	8(8)	2(2)	..	..	..	..	..	..	
The Sound	June	1	30	..	..	25(25)	27(27)	1(1)	..	..	..	
Belt Sea	Apr.-Aug.	27	290	30(223)	21(199)	0.1(1)	..	..	..	..	..	
	1921											
Kattegat	July-Sept.	16	255	135(1147)	10(82)	..	..	..	..	..	..	
Belt Sea	May-Sept.	23	324	49(369)	9(99)	0.1(1)	..	..	..	..	..	..
W. part of Baltic proper	Aug.-Sept.	4	60	12(23)	0.5(1)	..	..	..	..	..	..	
	1922											
Kattegat	Apr.-July	4	60	..	2(4)	2(4)	..	..	..	..	..	
Isefjord	May	1	35	..	3(4)	2(3)	..	..	..	..	..	
The Sound	May	9	115	..	6(24)	1(4)	0.3(1)	0.3(1)	0.8(3)	..	..	
Belt Sea	Apr.-Oct.	29	410	4(39)	18(252)	1(20)	0.1(2)	..	..	..	..	
Western Baltic	May	1	25	..	4(3)	..	..	..	..	..	..	..
W. part of Baltic proper	May	4	70	..	3(8)	0.4(1)	..	..	..	..	..	..
	1923											
Isefjord	July	7	90	24(72)	3(9)	7(22)	3(8)	..	..	..	..	
The Sound	July-Oct.	10	145	13(61)	9(44)	2(9)	1(5)	0.2(1)	0.4(2)	..	..	
Belt Sea	Apr.-Oct.	36	480	113(1474)	1(19)	6(95)	1(19)	0.4(7)	0.06(1)	0.1(2)	..	
W. part of Baltic proper	Aug.	3	45	30(45)	1(1)	..	..	..	..	..		
	1924											
Kattegat	July	1	15	..	10(5)	..	..	..	..	..	..	
Isefjord	May-July	6	85	0.5(1)	39(111)	2(6)	3(8)	0.4(1)	..	..	..	
The Sound	May-Sept.	19	340	0.5(4)	9(109)	3(30)	13(147)	2(18)	0.09(1)	..	..	
Belt Sea	Apr.-Sept.	42	599	4(66)	54(1051)	2(31)	2(32)	0.3(5)	0.2(3)	..	..	
Western Baltic	May	1	10	..	3(1)	..	..	..	..	..	..	
W. part of Baltic proper	June-Aug.	10	383	0.08(1)	11(142)	..	0.5(7)	0.01(8)	..	..	..	
	1925											
Kattegat	May-Sept.	10	196	43.9(155)	5(32)	2(13)	..	..	..	..		
The Sound	May-Sept.	19	478	2(24)	0.2(3)	13(213)	0.3(4)	0.6(9)	0.07(1)	..	..	
Belt Sea	Apr.-Aug.	36	785	40(849)	4(109)	18(474)	0.3(7)	0.08(2)	0.04(1)	..	..	
Western Baltic	May-Aug.	3	38	..	3(3)	0.8(1)	..	..	..	..	..	
W. part of Baltic proper	Apr.-Aug.	16	110	1(3)	0.3(1)	3(12)	..	0.3(1)	..	..	..	..
Round Bornholm	April	7	220	..	5(4)	..	2(12)	0.9(7)	0.1(1)	..	..	
	1926											
Kattegat	Apr.-July	25	321	0.2(2)	31(331)	2(24)	0.5(5)	..	..	..	..	..
Isefjord	May	6	75	..	3(8)	16(41)	9(22)	0.3(1)	..	..	..	
The Sound	June-Sept.	17	248	0.2(2)	29(238)	5(44)	15(127)	0.1(1)	0.2(2)	..	..	..
Belt Sea	Apr.-Sept.	67	1295	0.8(22)	45(1929)	5(205)	10(425)	0.2(9)	0.07(3)	0.05(2)	0.02(1)	..
W. part of Baltic proper	June-Aug.	18	270	..	7(67)	..	1(11)	..	..	..	..	..
Round Bornholm	Aug.	12	210	0.1(1)	15(105)	3(24)	2(16)	1(8)	0.1(1)	0.3(2)	..	0.1(1)
	1927											
Kattegat	May-July	66	1251	3(70)	0.9(35)	3(120)	0.2(9)	0.3(12)	..	0.05(2)	..	..
The Sound	June	6	200	0.5(3)	..	9(57)	1(7)	0.5(3)	..	..	..	..
Belt Sea	May-Oct.	42	815	15(322)	0.6(16)	10(274)	1(37)	2(44)	0.1(3)	0.07(2)	..	..
Western Baltic	Aug.	6	135	44(198)	0.2(1)	2(8)	0.2(1)	0.2(1)	..	..	..	..
W. part of Baltic proper	June-Sept.	17	440	9(131)	0.1(2)	2(24)	0.3(4)	1(15)	..	0.07(1)	..	..
Round Bornholm	Aug.-Sept.	27	530	7(117)	2(28)	0.2(4)	0.5(8)	0.4(7)	0.06(1)	0.06(1)	..	..
	1928											
Kattegat	Apr.-Aug.	40	695	43(1001)	7(154)	0.1(3)	0.1(3)	..	..	..	..	..
Isefjord	Aug.	5	109	346(1256)	0.8(3)	..	..	..	..	..	..	..
Belt Sea	May-Aug.	80	1999	14(548)	12(778)	0.7(45)	6(368)	0.6(40)	0.4(26)	0.03(2)	0.05(3)	0.02(1)
Western Baltic	June-July	10	290	6(62)	15(153)	0.1(1)	5(49)	..	0.2(2)	..	0.3(3)	0.1(1)
W. part of Baltic proper	May-Aug.	23	650	10(41)	2(38)	0.2(5)	1(27)	0.2(5)	0.2(5)	0.05(1)	..	..
Round Bornholm	Aug.	28	695	11(283)	1(23)	0.1(2)	0.7(16)	0.3(8)	0.04(1)	0.04(1)		
	1929											
Kattegat	Apr.-Sept.	68	1408	12(559)	7(303)	1(52)	0.02(1)	0.3(15)	0.04(2)	0.09(4)	..	
Isefjord	Apr.-Oct.	13	365	14(174)	26(313)	0.08(1)	..	..	..	..	..	
The Sound	Apr.-Aug.	13	270	0.2(2)	..	..	5(51)	1(13)	0.06(5)	..	..	
Belt Sea	Apr.-Oct.	44	817	18(396)	9(257)	4(100)	..	0.6(15)	0.1(3)	0.07(2)	..	..
Western Baltic	Oct.	1	15	2(1)	..	..	..	..	..	..	..	

[1]) For the calculation of the number of the 0-group only hauls taken after the 1. June are considered.

to age determination or whose age could be determined from measurements (the 0-Gr. and in some cases the I-Gr.). In the Table is given the number of such hauls in the different areas for each year, the duration of the haul, and the number of cod of the various age groups caught in half an hour in each area in each year from 1919 till 1929. When some of the cod (especially the younger ones), but not the older ones, have been subjected to age determination, I have included the haul when the not aged individuals have been very few and the number of those aged has been very large. The results relating to the frequency of the separate age groups rest therefore on the surest foundation for the younger groups, being unreliable for the older groups — from about the V-Gr. upwards. This unreliability arises not only from the fact that comparatively many of the individuals in these groups have not been examined for age but also from there being so few individuals caught that belong to these older groups.

In Figs. 31—40 are given the numbers of cod of the younger age groups caught per half hour with the tog in 1927, 1928, and 1929. All the individuals caught in these years were aged and all the stations where the tog was used are entered on the Charts.

We will now in the following proceed to an investigation, based on the results of the fishery with the tog in the years 1919—1929 described above, of the fluctuations in the numerical abundance of the year classes from year to year. This investigation will in the main be limited to the 0-, I- and II-Groups, since we possess the largest and consequently the most reliable material of these three groups.

a. 0-Group.

Bottom stages of the 0-Gr. of about 5 cm. length begin to appear in the catches with the tog already in May, and in June there are a great number of them. From June onwards they are taken with the tog as late in the year as this experimental fishery is carried on, i. e. until the middle of October. The largest numbers occur in the catches from August till October (see Charts, Figs. 31—33). In order to render comparable the catches in the different years I have calculated the average catch per half hour, and in the case of the 0-Gr. I have only included the hauls taken during the months June—October since the individuals of this group are not large enough in May to be caught with the tog in numbers which correspond to the real numerical strength of the group. In June not all the cod larvae have yet become large enough to be retained by the meshes of the tog, but so many have attained this size that we are justified in including June, and the more so since the material (numbers of hauls) is considerably augmented by the inclusion of this month in our calculations. In the calculations of the frequency of the 0-Gr. hauls taken outside the 30 m. line have not been included, (as this group does not commonly occur in deeper water) except from the waters around Bornholm and the Arcona Basin.

We will first consider the conditions in the Belt Sea, the most fully investigated area.

The following numbers of cod of the 0-Gr. were caught in the Belt Sea per half hour during the months June—October in the different years:—

Year	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	Average
Year class	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	
No. per ½ hour	**55**	**30**	**49**	**4**	**113**	**4**	**40**	**0.8**	**15**	**14**	**18**	**31**
No. of stations	34	21	19	19	33	31	35	36	33	48	33	

The annual fluctuations are thus very pronounced, especially during the years 1921—1926. The figure for 1927 should undoubtedly have been higher than it is (15); in this year only one experimental

haul was made in the Belt Sea throughout the period July—October, while 32 hauls were made in June when one can not yet reckon with the full number of cod of the 0-Gr. In the one haul (in October) 146 cod of the 0-Gr. were taken in half an hour whereas the average number in June was 8. In order

Fig. 31. Number of cod of the 0-group caught per 30 minutes in tog in 1927.

to ascertain what this figure for June signifies in estimating the frequency of the 0-Gr. in this year we will set down the June figures in the different years:—

June

Year	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Year class	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
No. per ½ hour	**0**	**1**	**4**	**0**	**4**	**0.3**	**13**	**0.2**	**8**	**0.1**	**0**
No. of stations	1	3	3	3	1	2	17	23	32	12	1

If we consider the four years 1925—1928 during which extensive investigations were carried out in June we shall see that there were far more cod of the 0-Gr. in 1927 than in 1926 and 1928 but not so many as in 1925 — only about two thirds. We can thus safely assume that 1927 was much better than 1928, although not so good as 1925; the figure 15 for the months June—October is thus actually too low for 1927. The chief result obtained from considering the fluctuations in the frequency of the 0-Gr. in the Belt Sea is therefore that the years 1919, 1921, 1923, 1925, and presumably also 1927 were rich, whereas 1922, 1924, and 1926 were poor, 1920, 1928, and 1929 being below normal.

As regards the other areas in which the investigations were not so extensive as in the Belt Sea, the conditions were much the same. A table showing the frequency of the 0-Gr. in the different years in these areas is given below. The figures also here denote the average catch per half hour for the months June—October:—

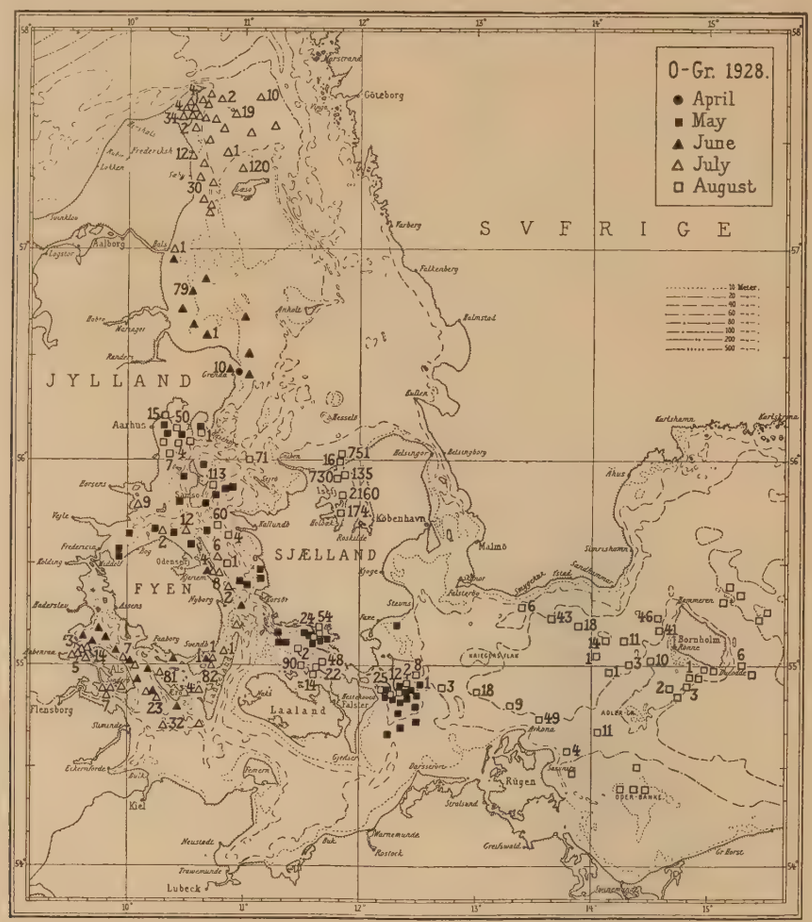

Fig. 32. Number of cod of the 0-group caught per 30 minutes in tog in 1928.

		1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	Average
Year		1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	
Kattegat	No. per ½ hour	**48**	..	**135**	**0**	..	**0**	**44**	**0.2**	**3**	**43**	**12**	**32**
	No. of stations	2	..	16	1	..	1	6	24	29	39	56	
The Sound	No. per ½ hour	..	**0**	..	..	**13**	**0.5**	**2**	**0.2**	**0.5**	..	**0.2**	
	No. of stations	..	1	..	..	10	15	13	17	6	..	2	
West. Baltic	No. per ½ hour	..	..	..	..	..	..	**0**	..	**44**	**6**	**2**	
	No. of stations	..	..	..	..	..	..	1	..	6	10	1	..
West. part of Baltic proper	No. per ½ hour	..	..	**12**	..	**30**	**0.1**	**1**	**0**	**9**	**10**	..	..
	No. of stations	..	..	4	..	3	10	11	21	17	6	..	..
Round Bornholm	No. per ½ hour	..	..	..	..	..	..	..	**0.1**	**7**	**11**	..	..
	No. of stations	..	..	..	..	..	..	..	12	26	28	..	..

In the case of the Kattegat, 1919, 1921, 1925, and 1928 were thus good years, whereas 1922, 1924, and 1926, and to a lesser extent 1927 and 1929, were bad years. No investigations were carried out in 1920 and 1923.

As regards the years 1919—1926 the fluctuations in frequency observed in the Kattegat accord with those observed in the Belt Sea; as regards 1927 and 1928 however there is a discrepancy. That the figures for the catches in 1927 are so low is perhaps due to no hauls having been made in this year later than July; in the Western Baltic where hauls were made in August the figure for the catches was as high as 44. That the figure for 1928 is so extremely high is due to a single haul made in August immediately in front of the entrance to the Isefjord which produced no less than 751 cod of the 0-Group (in all 1001 of the 0-Gr. were caught in the entire Kattegat in the summer of 1928). These many cod of the 0-Gr. at the entrance to the Isefjord in August undoubtedly originated for the most part from the Isefjord which at this time of the year contained a very large number of cod of the 0-Group; thus on the 3rd and 4th of August 346 cod of the 0-Gr. were taken per half hour in 5 hauls (total duration 109 minutes).

The investigations in the other areas, as appears in the Table overleaf, were so scanty that we cannot from them obtain a picture of the fluctuations from year to year, but the separate observations are in close agreement with the results from the Belt Sea and the Kattegat.

The following observations from trawling operations carried out from the "Dana" in the eastern part of the North Sea show as far as the investigations go that these fluctuations also occur in the waters outside the Skaw. In the Horns Reef Area 3 cod of the 0-Gr. were thus caught per hour in 37 hauls in the autumn of 1922 whilst no less than 25 were caught per hour in 10 hauls in 1925. 1925 was thus also in the Horns Reef Area a better survival year than 1922.

Fig. 33. Number of cod of the 0-Group caught per 30 minutes in tog in 1929.

b. I-Group.

The I-Group of the cod are frequently taken with the tog in all the months in which fishing experiments are carried out. The individuals of the I-Gr. are not — even in the spring — so small that there can be any question of their escaping through the meshes of the tog. In calculating the frequency the hauls are consequently included from all the months in which trawling operations were carried on.

The following number of the I-Gr. of cod were thus taken per half hour in the different years in the Belt Sea:

Year	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	Average
Year class	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	
No. per ½ hour	**17**	**21**	**9**	**18**	**1**	**54**	**4**	**45**	**0.6**	**12**	**9**	**18**
No. of stations	36	27	23	29	36	42	36	67	42	80	44	..

Fig. 34. Number of cod of the I-Group caught per 30 minutes in tog in 1927.

If we compare these results with those which have been given for the 0-Gr. we see that a year after the 0-Gr. has been large we have a large I-Gr., and that a year after the 0-Gr. has been small we have a small I-Gr.

If we tabulate the results for the Kattegat we obtain a somewhat similar picture.

Kattegat

Year	1919	1921	1922	1924	1925	1926	1927	1928	1929	Average
Year class	1918	1920	1921	1923	1924	1925	1926	1927	1928	
No. per ½ hour	**9**	**10**	**2**	**10**	**5**	**31**	**0.9**	**7**	**7**	**9**
No. of stations	2	16	4	1	10	25	66	40	68	..

In the years 1924—1928 the fluctuations are in close agreement with those observed in the Belt Sea. This is however not the case in the years 1919—1922. Within this period however it was only in a single year (1921) that an investigation of any extent was carried out. As regards the years 1924—1928,

it again here holds good that in the year after there has been an abundant 0-Gr. there is an abundant I-Gr. In the more scanty results from the years 1919—1922 no such agreement can be observed for this area.

These more extensive investigations date no further back than 1919. One or two isolated observations were however made in 1918 which show the frequency of the I-Gr. and 0-Gr. in this year.

Fig. 35. Number of cod of the I-Group caught per 30 minutes in tog in 1928.

On October 4th 1918 off Vresen in Great Belt 4 hauls were taken with the tog in altogether 36 minutes; in these hauls 151 cod in all were taken which were distributed as follows among the different age groups:

0-Group	6 individuals	III-Group	1 individual
I- —	138 —	IV- —	1 —
II- —	5 —		

The 0-Gr. (year class 1918) is thus numerically rather poor, which accords with the weakness of the II-Gr. in 1920 (see Section c). The number of fry produced in 1918 was thus evidently somewhat below normal. The I-Gr. (year class 1917) is extremely numerous in comparison with the other groups, which accords with the great abundance of the II-Gr. in 1919 (see Section c). 1917 must thus clearly be counted among the good years for fry.

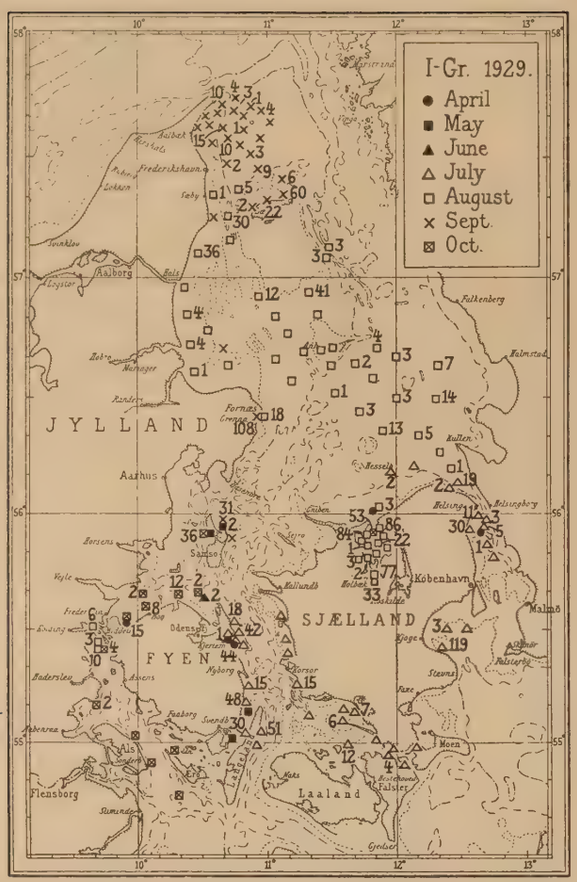

Fig. 36. Number of cod of the I-Group caught per 30 minutes in tog in 1929.

We find the same fluctuations in the numbers of the I-Gr. in the fishery with trawl as with the tog. The I-Gr. thus proved to be far less numerous in 1923 than in 1926 also in the trawl fishery. In 1923 4 individuals were caught in the Kattegat per trawling hour and 0.1 in the western portion of the Baltic proper; in 1926 on the other hand 17 cod of the I-Gr. were caught per trawling hour in the Kattegat, 12 in the Belt Sea, and 8 in the Western Baltic.

c. II-Group.

The material which can throw light on the fluctuations in the frequency of the II-Gr. of the cod is not so comprehensive as that which refers to the 0- and I-Groups, firstly for the reason that not nearly as many individuals of the II-Gr. are taken with the tog as of the 0- and I-Groups, and secondly because cod of this group have not been examined for age in a number of cases — i. e. chifly in the earlier years of the period 1919—1929 — and it not being possible to determine what fish belong to the II-Gr. solely by measurement of length as one can do in many cases with the 0- and I-Groups.

The average number of cod of the II-Gr. caught in the Belt Sea per half hour with the tog in the years 1919—1929 is given in the Table below:

Year	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	Average
Year class	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	
No. per ½ hour	**10**	**0.1**	**0.1**	**1**	**6**	**2**	**18**	**5**	**10**	**0.7**	**4**	**5**
No. of stations	36	27	23	29	36	42	36	67	42	80	44	..

The II-Gr. was thus comparatively numerous in 1919, 1923, 1925, and 1927; this means that 1917, 1921, 1923, and 1925 were good years for fry, which again accords with the abundance observed in 1921, 1923, and 1925 of the 0-Gr. and in 1918, 1922, 1924, and 1926 of the I-Gr. The numerous II-Gr. in 1919 shows that the 1917 year class (which was not examined as 0-Gr.) was comparatively numerous.

In 1920, 1921, 1922, 1924, and 1928 the II-Gr. was not very numerous. According to the catches of the 0-Gr. in 1919 and of the I-Gr. in 1920 we should have had a fairly abundant II-Gr. in 1921. That we however have not been able to demonstrate a corresponding abundance in the II-Gr. in 1921 may be due to the fact that a sufficient number of age determinations were not carried out on the rather large cod in this year. In 1926 and 1929 the numbers of the II-Gr. were normal or below normal, On the whole (with the exception of 1921 and 1929) the observations on the frequency of the II-Gr. agree with the corresponding catches of the I- and 0-Groups one and two years before respectively.

d. The numerical strength of some older year classes in the catches in different years.

The material relating to the age groups from the III-Gr. upwards is too scanty to afford a consecutive series of observations. But in certain years enough individuals were taken to render possible some conclusions as to the frequency of each year class, and as far as the observations go they are in close

Fig. 37. Number of cod of the II-Group caught per 30 minutes in tog in 1927.

accordance with the results established in the preceding Sections (a, b, c.) as regards the relative frequency of the year classes.

In 1928 the following number of individuals of the different year classes were caught in the Belt Sea at 80 stations:

Year class	1928	1927	1926	1925	1924	1923	1922	1921	1920
No. of individuals	548	778	45	368	40	26	2	3	1

From this it will be seen that the 1927 and 1925 year classes (Grs. I and III) were especially abundant and 1926 (Gr. II) especially poor.

In 1927 (see Table 21) the year classes 1927 (0-Gr.), 1925 (II-Gr.), and 1923 (IV-Gr.) were especially abundant in the Belt Sea, Kattegat, and Western Baltic.

Similarly in 1926 the year classes 1925 (I-Gr.) and 1923 (III-Gr.) were especially abundant in the Belt Sea and the Sound.

In 1925 the 0-, II-, and IV-Groups, i. e. the year classes 1925, 1923, and 1921 were especially abundantly represented in the catches in the Belt Sea and in the Sound.

Also in 1924 the year classes 1923 (I-Gr.) and 1921 (III-Gr.) were very abundant in these two areas.

In 1923 and previous years the numbers of older cod subjected to age determination were so small that no reliable information could be gathered as to the numerical strength of the older year classes.

Fig. 38. Number of cod of the II-Group caught per 30 minutes in tog in 1928.

e. The effect of rich or poor year classes on the cod stock which is fished upon.

It has been shown (Section c and d) by fishing experiments with tog and trawl that the good and bad survival years for fry exert a powerful influence on the numbers of the II- and III-Groups, i. e. on the numerical strength of the youngest year classes of the stock which is the object of fishing operations. At the fishing experiments where only fairly small and finemeshed implements are used, only a small number of the somewhat larger cod from the IV-Gr. upwards are caught — i. e. of the very age groups which constitute the largest part of the commercial fishery yield. In order to investigate to what a degree the good and bad survival years exert an influenee on the size of the stock of older (and larger) cod in our waters, we must therefore consider the age composition of some samples of cod (see Table 15, A—H) derived from the commercial fisheries at various localities in our waters. In the Table below these

samples which have all been caught in the course of 1929 are tabulated according to their year class. A sample from Livø Broad where only the I-Gr. was found, and a sample from Thyborøn comprising only smaller fish (I-Gr.) are omitted in this Table, the 2 samples from the waters S. of Bornholm being also omitted as the yearly fluctuations in the numbers of fry have not been investigated at all in this area. The figures in the Table denote the number of individuals of the separate year classes.

Year class	1928	1927	1926	1925	1924	1923	1922	1921
Frederikshavn $^{10}/_{5}$ 1929	5	194	18	28	5	3	2	
Kerteminde Bay $^{2}/_{5}$ 1929	..	37	8	42	5	6	1	..
Smaalandshavet $^{11}/_{1}$ 1929	..	2	6	49	2	..	..	1
Aabenraa Fjord $^{9}/_{5}$ 1929	..	22	3	67	9			
Total ...	5	255	35	186	21	9	3	1

It will be seen from this Table that by far the greatest part of the cod which were caught in the inner Danish waters in the first half of 1929 belonged to the year classes 1927 and 1925. The 1926 year class was on the other hand very poor. The 1928 year class was still at this date only to a very slight extent the object of fishing operations on account of the smallness of its individuals. A few of the 1924 year class were caught, but there were only very few individuals of the older year classes in the samples. Similarly at the scientific fishing experiments the 1925 and 1927 year classes proved to be abundant, whilst the 1926 year class was poor; the samples from the commercial fisheries thus show a similar numerical relation between the different year classes to that found at the investigations of the 0-Gr. (both larvae and bottom stages), the I-Gr., and the II-Gr.

The two samples from the commercial fishery in Bornholm waters show a somewhat different relation between the numbers of the year classes.

Year class	1927	1926	1925	1924	1923
S. of Bornholm. Jan. 31st and May 12th 1929. No. of individuals	9	56	83	19	4

1925 was here as in our inner waters a very abundant year class, but the 1926 year class in contrast to what was the case in our other waters was also rich; this tends to show that not quite the same fluctuations take place in the Baltic around Bornholm as in our other waters. That the figure for 1927 is so small does not necessarily mean that the 1927 year class was poor in the Bornholm waters, as this may be due to the growth there being so slow that the individuals of this year class had not fully reached a marketable size.

Fig. 39. Number of cod of the II-Group caught per 30 minutes in tog in 1929.

f. Fluctations in the frequency of the different age-groups during the years prior to 1914.

The age analyses for the years prior to 1914 are rather scanty and do not give a complete picture of the fluctuations from year to year in the frequency of the different age groups throughout a long series of years.

A number of cod caught with the trawl from the "Thor" in 1905, 1906, 1907, and 1911 were

Fig. 40. Number of cod of the III-Group caught per 30 minutes in tog in 1928.

analysed for age. This material however is too small for conclusions to be drawn as to the varying frequency of the age groups. The hauls with the tog from the "Japetus Steenstrup" were also rather few, and the cod were only analysed for age in a few cases. In 1913 the following number of individuals in the different age groups were caught in 4 hauls with the tog in August and September, the total duration of the hauls being 106 minutes:

	number per half hour		number per half hour
0-Group	6	III-Group	1
I- —	1	IV- —	2
II- —	2		

According to these figures, the I-Gr. (1912 year class) and II-Gr. (1911 year class) seem to have been poorly represented. The IV-Gr. (1909 year class) was on the other hand comparatively abundant.

On August 28th and 29th 1913, 571 cod were caught with the Danish seine from the cutter "Ellen" ½ sea-mile S.S.W. of Schultz's Grund at a depth of 30 metres and analysed for age by Dr. A. C. Johansen; the individuals were distributed as follows among the different age groups and year classes:

I-Gr.	(year class	1912)	15 individuals
II-Gr.	(—	1911)	115 —
III-Gr.	(—	1910)	99 —
IV-Gr.	(—	1909)	114 —
V-Gr.	(—	1908)	162 —
VI-Gr.	(—	1907)	48 —
VII-Gr.	(—	1906)	18 —

The individuals of the I-Gr. are plainly still too small to be taken in representative numbers with the Danish seine; the catches of the II-Gr. are thus the first we can reckon with. It will be seen from the numbers observed that the 1908 year class was abundant.

In Langelands Belt, 355 cod were caught on hooks in the months April—June 1909; they were distributed as follows among the different age classes and year classes:

I-Gr.	(year class	1908)	4 individuals
II-Gr.	(—	1907)	52 —
III-Gr.	(—	1906)	175 —
IV-Gr.	(—	1905)	99 —
V-Gr.	(—	1904)	15 —
VI-Gr.	(—	1903)	4 —
VII-Gr.	(—	1902)	5 —
VIII-Gr.	(—	1901)	1 —

According to these analyses 1906 appears to have been a good year.

From the more scanty analyses, given above, for the years prior to 1914 it is not possible to draw up a complete table showing the fluctuations in the numbers of the different year classes, but the analyses tend to show that 1906 and 1908 were more than normally good years for fry.

3. Concise account of the Fluctuations in the Number of Larvae and in the Numerical Strength of the different Age Groups during the years 1917—1929.

Fig. 41 presents the collected data relating to the fluctuations in the numbers of larvae during the years 1923—1929 and in the numerical strength of the age groups 0-, I-, and II- during the years 1917—1929.

For the years subsequent to 1923 from which we possess, in addition to age analyses, the results of investigations on the number of larvae an agreement is clearly evident between the fluctuations in the number of larvae in the spring, the number of the 0-Gr. in the following summer, the number of the I-Gr. in the succeeding year, and the number of the II-Gr. the year after.

In the spring of 1923 there were unusually many larvae, and in the succeeding summer months there was found the most numerous 0-Gr. that has ever been observed in our waters; in the following year and the year after were found the most numerous I- and II-Groups respectively ever observed.

In 1924 the number of larvae was down at a minimum and the 1924 year class proved particularly poor, as 0-, I-, and II-Groups. This same sequence is found to occur in each of the year classes 1925,

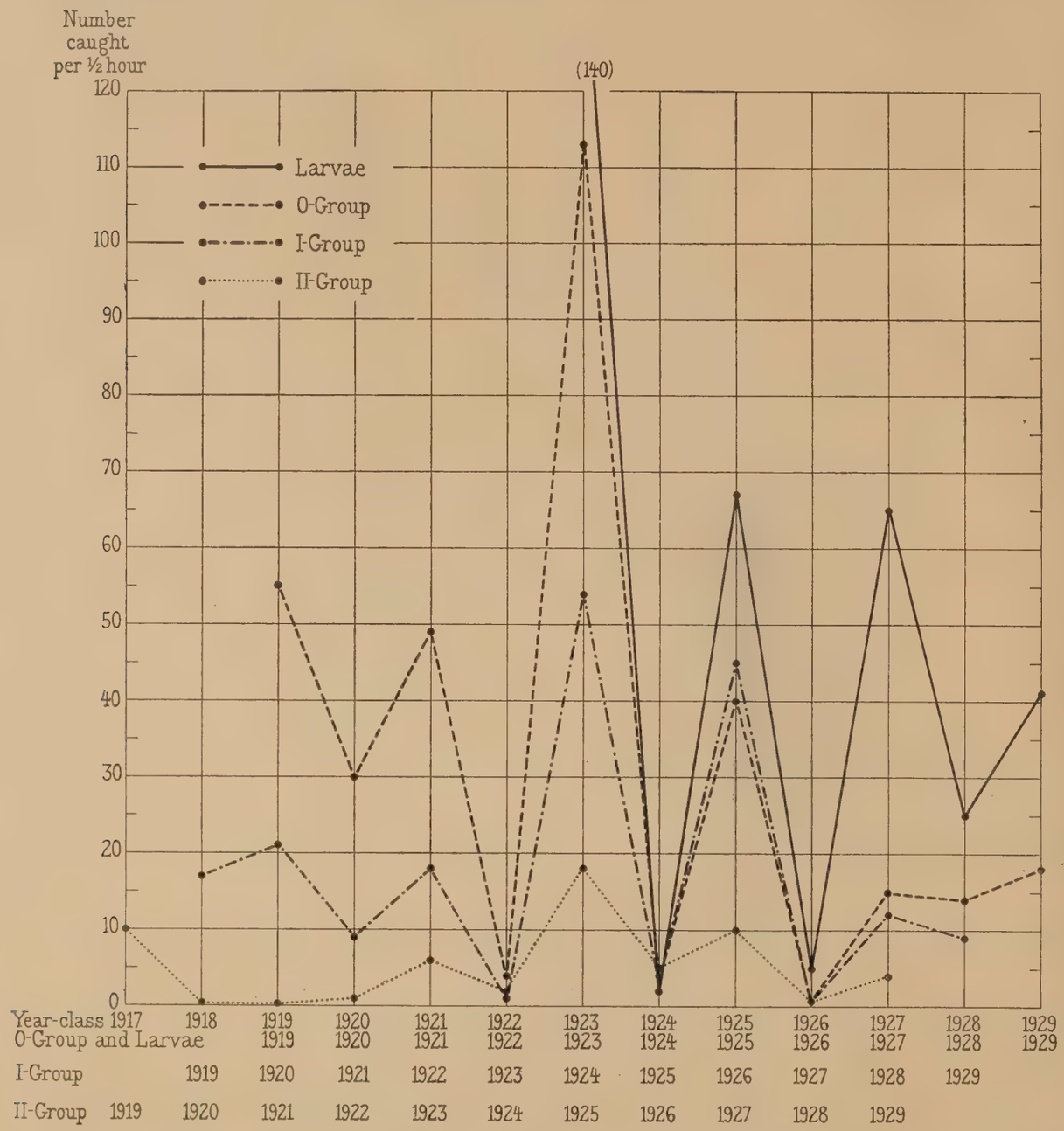

Fig. 41. Fluctuations in number of cod larvae in the years 1923—1929 and in number of individuals of the year classes 0, I, and II in the years 1919—1929.

1926, 1927, 1928, and 1929. This shows that in any given year the amount of fry produced has a preponderating influence on the numbers of this year class in the succeeding years, which means that

the conditions encountered by the cod in its larval stage have a far greater influence on the numbers of the year class in question in the succeeding years than all the other external influences combined which this year class encounters later. It is thus the larval stage which is the critical stage of the cod's life. Once a year class of cod has emerged successfully from the larval stage it will play an important part in the cod stock in the course of the coming years. This means again that by determining the number of larvae that grow up in a given year we have a good means of judging how important this year class will be for the fishery. The fact that the conditions encountered by the cod in the larval stage exert a decisive influence on the size of the stock in the succeeding years is in agreement with the theory set forth by J. Hjort (1914, p. 203) based on the investigations of the herring and cod stock off the west coast of Norway: "The rich year classes thus appear to make their presence felt when still quite young; in other words the numerical value of a year class is apparently determined at a very early stage, and continues in approximately the same relation to that of other year classes throughout the life of the individuals."

The fact that it is as early as in the larval stage that the abundance of the year classes mainly is determined is from a practical point of view of interest in the case we should proceed to artificial rearing of larvae of cod fishes.

No investigations were carried out on larvae from which we can estimate the numbers of the 1917—1922 year classes but only investigations on the bottom stages. But from the agreement observed between the fluctuations in the numbers of larvae in each year of the period 1923—1929 and the fluctuations in the numbers of the 0-, I-, and II-Groups of the corresponding year classes we can draw the conclusion that if we have observed a particularly abundant 0-Gr. (or I- or II-Group) in any given year we can assume that there was an especially large number of larvae when this age group was in the larval stage. If we now consider the curves in Fig. 41 for the years 1919—1922 we shall see that 1919 and 1921 were good years for fry whilst 1920 and 1922 were bad.

The material is less reliable when we come to estimate the numbers of larvae in 1917 and 1918 as it is only the II- and I-Groups that afford data for this purpose, but the numbers of these age groups tend to show nevertheless that 1917 was a good year for fry whilst 1918 was less good.

The main result of these continuous fishing experiments with the tog during the period 1919—1929 concerning the annual fluctuations in the numbers of cod fry is thus that throughout the years 1917—1927 (11 years) good and bad survival years have alternated regularly, so that each other year has been a good year and each other year a bad year for fry. The years 1917, 1919, 1921, 1923, 1925, and 1927 have been good years for fry, in which large numbers of cod fry have been produced, whilst the years 1918, 1920, 1922, 1924, and 1926 have been bad years. Divergencies from the normal during this period have been greatest for the year classes 1922, 1923, and 1924. The 1928 and 1929 year classes have both approximated fairly closely to normal.

IX. The Causes of the Annual Fluctuations in the Amount of Fry.

It has been shown in the preceding Section that in our inner waters and to some extent also in the North Sea there were extremely great fluctuations in the amount of fry from year to year during the period 1917—1929. These fluctuations which were observed at the investigations on the amount of larvae and on the numbers of individuals in the younger age classes have proved (as may be seen from the age analyses of cod caught in commercial fishing operations) to have a great influence on the number of cod which at any given time are available for fishing. It is therefore interesting not only from a purely scientific point of view but also from a practical standpoint to acquire an understanding of the causes of these great fluctuations in the age composition of the cod stock.

The causes of the annual fluctuations in the amount of fry of the different species of fish have for many years been the subject of investigations. One ore more of the following factors could be regarded as possible causes of the fluctuations:

1. Variations in the quantity of spawned and fertilised eggs, which again depends on the variations in the quantity of spawning fish.
2. More favourable or less favourable conditions for the development of the eggs in the sea.
3. More favourable or less favourable conditions during the larval stage.
4. The influence of the marine currents on the drifting of eggs and larvae.
5. The enemies of the eggs and larvae.

As regards the first point, the previous investigations tend to show that in the case of those species of fish which spawn great quantities of eggs such as the plaice, cod, and haddock there is no pronounced agreement between the variations in the numbers of the spawning fish and the variations in the amount of fry.

Hjort (1914) calculated the amount of cod roe when the size of the cod is known, and was thereby able to show in which years much roe is spawned at Lofoten and in which years a small amount, and by correlating these observations with the investigations into the relative number of individuals in the different year classes he has shown (p. 204) "the very years in which the quantity of roe at Lofoten was least to be those which produced the richest fishery year classes".

Harold Thompson (1924, p. 6) observed something of the same kind with respect to the haddock; he shows that in 1923 unusually large numbers of haddock larvae appeared in the North Sea, but that nevertheless the number of spawning haddock in this year was if anything less than in the preceding years in which the amount of larvae was far less than in 1923. Even though this observation is only based on two or three years it is however definite enough to show that it is not the number of spawning haddock which alone determine the amount of haddock fry produced.

A similar observation has been made by A. C. Johansen (1927) in the case of the plaice which, like the cod and haddock, spawns many eggs. He writes in this connexion (p. 7): "As regards to the variations in numbers of spawning fish or of fish eggs, there are various points which suggest that this factor cannot be the principal cause of the fluctuations in the quantity of young fish. I may point out for instance, that during the period 1893—1904 when the stock of plaice in the Belt Sea and southern Kattegat was not as yet greatly affected by the fishery and when the numbers of spawning fish cannot have varied to any great extremes from year to year, there were nevertheless great fluctuations in the numbers of young fry."

The case is otherwise of course in respect to the fish which spawn comparatively few eggs, e. g. salmon, trout, and to a lesser extent herring. J. P. Jacobsen and A. C. Johansen (1921) have shown that as regards salmon the number of spawning fish has a great influence on the amount of fry which develops, and Aage J. C. Jensen (1927) has shown by statistical calculations that as regards the Bornholm herring the number of spawning fish probably influences the fluctuations in the amount of fry.

The previous investigations (Hjort and Thompson) then have tended to produce such results that we may assume that in the case of cod the number of spawning fish and of the spawned eggs have only a slight influence on the abundance of any given year class available for fishing.

An investigation into the question of to how great an extent the fluctuations in the number of spawning cod in the inner Danish waters agrees with the number of larvae produced is rendered difficult by the fact that the bulk of the cod in our waters are fished during the months October—April, whilst the Danish fishery statistics give the yearly catch according to the calendar year. In order to compare the number of spawning cod with the number of larvae we ought to compare the latter with the number of cod caught during the spawning season (Jan.—April) or at all events during the fishing period

(Oct.—April). As such a comparison is not however feasible we are prevented from investigating by this method the influence of the number of spawning fish on the number of larvae produced.

However the fact that during the years 1923—1928 the fishery yield in the Belt Sea rose fairly steadily (see p. 101) without great variations from year to year, whilst at the same time the number of larvae fluctuated greatly, indicate that there is only a slight connexion between the number of spawning cod and the number of larvae if the stock of cod has reached a certain size.

A more accurate comparison can be made by comparing the number of cod eggs observed at the Hensen net investigations with the number of larvae. Such a comparison is given here. It includes observations from both the German and the Danish waters.

Belt Sea.

Year		1909	1911	1912	1922	1923	1924	1925	1926	1927	1928	1929
Larvae per 1/2 hour	April & May	3	0.6	0.1	..	140	2	67	5	63	25	41
Eggs per sq. metre of surface	Feb.	5 [1]	56 [3]	..	..	..	..	..	..	..		
	March	3 [1]	71 [3]	5 [4]	76 [5]	..	..	..	..	37	..	..
	April	19 [2]	11 [3]	20 [4]	..	7	63	5	..	23	..	20
	May	3 [2]	3 [3]	..	..	0	..	..	2	..	..	1

Western Baltic.

Year		1909	1911	1912	1922	1923	1924	1925	1926	1927	1928	1929
Larvae per 1/2 hour	April & May		0.2	0		7		22	7	84		15
Eggs per sq. metre of surface	Feb.	..	33 [3]	..	..	..	..	..	..	..	..	..
	March	..	19 [3]	..	107 [5]	..	..	..	..	39	..	..
	April	..	0 [3]	17 [4]	82 [5]	33	72	11	..	44	..	36
	May	..	0 [3]	16 [4]	..	..	..	..	..	..	..	

[1]) Apstein 1911, [2]) Kramp 1913, [3]) Heinen 1912, [4]) Hensen 1919, [5]) Kramp 1924.

Despite the many lacunae in this Table we receive some indications which help us in estimating the influence of the number of eggs on the number of larvae. During the period 1909—1912 there was one year in which cod eggs were especially abundant both in the Belt Sea and the Western Baltic, viz. 1911; there were however very few larvae in this year in both areas. During the period 1922—1927 there were fairly many eggs in each year, with the exception perhaps of 1926 in which year however the egg investigation were only carried out in May. The most numerous eggs were found in 1924 when the larvae were very few in number; in 1923 when there were very many larvae the number of eggs was even considerably less than in 1924. These observations tend to show that if the stock has a certain considerable size, then the amount of larvae produced in a given year is dependent only to a slight extent on the number of eggs produced, i. e. on the number of spawning fish, but the observations are too scanty for us to regard the question as decisively settled thereby.

With regard to the points 2 and 3 — the influence of external conditions on the development and growth of the eggs and larvae — it is impossible to deal with them separately, since the spawning and development of the pelagic eggs take place over a long period simultaneously with the development of the larvae (during the months March and April).

We have seen in a preceding Section (p. 73) that during the years 1923—1929 very great fluctuations occur in the number of fry in the Belt Sea. We have therefore special reasons to investigate what the hydrographical conditions have been in the Belt Sea during this period.

Since the cod larvae, as already mentioned (p. 42), are found chiefly in the lower water layers it is to be expected that it is the hydrographical conditions in these lower water layers which determine the number of larvae which develop. From the hydrographical observations carried out several times daily from Halskov Rev Lightship (situated in 20 metres of water in Great Belt) we obtain a good impression of the changes in temperature and salinity in the Belt Sea. As seen in Section V, larvae are found chiefly in March, April, and May; we will therefore commence by investigating whether there is an accordance between the yearly fluctuations in the mean temperature of the bottom water during the three months taken together and the fluctuations in the amount of fry. A comparison between the two follows:

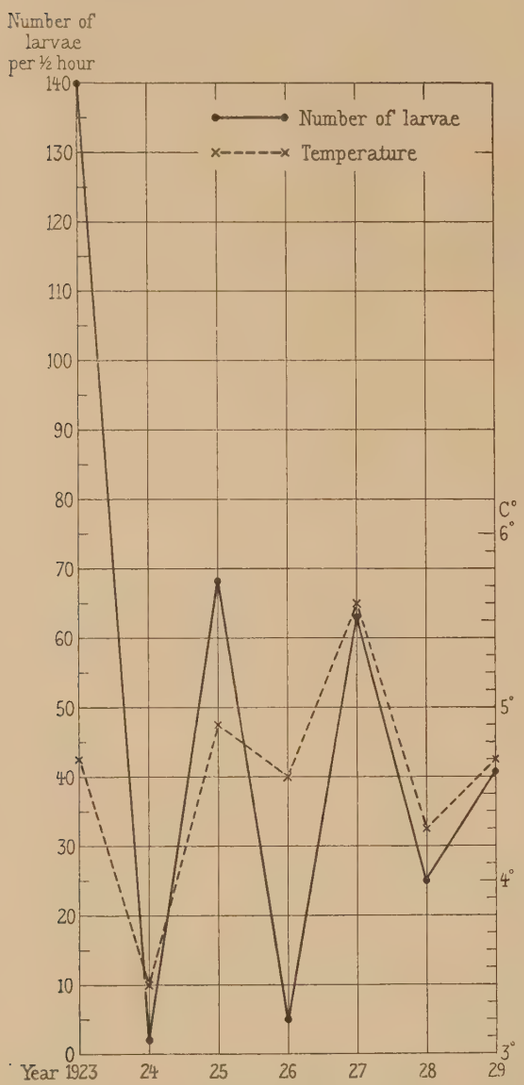

Fig. 42. Fluctuations in the number of cod larvae caught with a 2 metres ringtrawl per 30 minutes in the Belt Sea in the years 1923—1929 compared with the temperature of the bottom water at Halskov Rev light-vessel in March, April, and May.

Year	1923	1924	1925	1926	1927	1928	1929	Average
No. of larvae per ½ hour in April and May, Belt Sea	140	2	67	5	63	25	41	49
Mean temp. March—April—May	4.7	3.4	4.9	4.6	5.6	4.3	4.7	4.6

The above is presented in graphic form in Fig. 42, which shows that there is a distinct accordance between the variations in the temperature and the fluctuations in the amount of larvae, so that a relatively high temperature coincides with a large number of larvae and a relatively low temperature with a small number of larvae.

Fishing experiments with the tog have shown (p. 90) that the years 1918, 1920, and 1922 were bad survival years, whilst 1917, 1919, and 1921 were good survival years. It is therefore of interest to see whether an accordance between the temperature and the amount of fry also exists in the period 1917—1922 similar to that observed in the period 1923—1929. The hydrographical observations from Halskov Rev Lightship do not however date farther back than July 1921 and we must therefore for this period use the observations from the Lightship at Schultz's Grund which is situated at the northern entrance into the Belt Sea. In the Table below is given the average temperature of the bottom water (26 m.) at Schultz's Grund for the months March, April, and May during the period 1917—1929 together with for the years 1923—1929 the average catch of larvae per ½ hour in the Belt Sea and for the years 1917—1922 statements showing whether the corresponding year classes were abundant (+) or poor (÷).

Year	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Abundance of year classes, Belt Sea	+	÷	+	÷	+	÷	140	2	67	5	63	25	41
Temp. (Centigrade) in March—April—May	5.4	3.3	5.7	3.6	4.9	5.3	5.5	3.0	5.2	4.8	5.3	4.0	4.7

The above shows that also for the years 1917—1921 there is a distinct accordance between the temperature of the bottom water in the spring months and the amount of cod fry which develop; only 1922 forms an exception — according to the figures — in that the 1922 year class both as 0- and I-Gr. proves to be poor (see p. 78 and 82), despite the fact that the temperature of the bottom water in the spring months of 1922 was high.

In the case of the Kattegat, the fishing operations with the tog show that the 1919 and 1921 year classes were abundant whilst the 1920 and 1922 year classes were poor. The same state of affairs thus prevailed here as in the Belt Sea. A comparison between the temperature of the bottom water in the spring months at the Lightships Læsø Trindel, Læsø Rende, Anholt Knob, and Schultz's Grund and the catches of cod with the tog and of larvae with the ring trawl or fry trawl during the period 1919—1929 shows a close agreement between the temperature and the numbers of the year classes:

Year	1919	1920	1921	1922	1923	1924	1625	1926	1927	1928	1929
Abundance of year classes, Kattegat	+	÷	+	÷	61	2	46	7	6	..	23
Temp. (Centigrade) in March—April—May	5.3	4.8	5.4	4.5	5.9	3.7	5.3	4.8	5.4	4.4	4.5

There is thus both in the Belt Sea and Kattegat a very pronounced parallel between the variations in the amount of cod larvae and the fluctuations in the temperature of the bottom water during the months March, April, and May, the high temperatures coinciding with large numbers of larvae and the low temperatures with small numbers of larva.

There is reason to suppose that the fact of high temperatures being favourable for the fry is due to their producing a large amount of plankton, i. e. better food conditions for the larvae.

The radius of action of a tiny cod larva is very small, and if it does not find abundant and easily accessible food as soon as the yolk is used up it will die. It is the amount of food which is the main factor in the life of a cod larva.

The question is now whether the amount of plankton depends on the temperature to such a high degree that it can exert a considerable influence on the number of larvae.

It is a well-known fact that the plankton in our waters is poor in the winter months and that it increases greatly in the early summer; C. H. Ostenfeld (1913, p. 83) writes as follows on the dependance of the phytoplankton on external conditions: "In my opinion temperature and light are the two external factors which have the greatest influence on the periodicity of the phytoplankton. That temperature is of decisive influence and constitutes the factor which first and foremost governs the occurrence of the species is generally accepted and is evident from so many circumstances. . . . .".

In this connexion it should be mentioned that A. C. Johansen (1927) has shown that the amount of plankton has a very great influence on the thriving of plaice larvae. There is therefore every reason to suppose that the more the temperature rises during the spring months the larger the amount of plankton, and thus of food, develops there, and the more favourable the food conditions become for the larvae. This is thus the cause of the pronounced agreement between the fluctuations in the temperature of the bottom water and those in the number of larvae.

No clear agreement has been found between the temperature of the bottom water in the winter months and the number of larvae in the spring; there is however an agreement in some measure between the temperature of the surface water in January and February and the number of larvae in the spring.

The cause of this is undoubtedly that when the surface water in mild winters is comparatively warm the winter minimum of the plankton does not sink so far as in more severe winters when the temperature of the surface water is low or even when there is a covering of ice for a long period; we therefore also see that the number of larvae is in general low in those springs which succeed severe winters, as in 1922 and 1924. After the severe winter of 1928—1929 however the number of fry was very nearly normal.

In this connexion it is of interest that A. C. JOHANSEN (1927) has found a positive correlation between the number of plaice fry on the one hand and both the number of days when there was a covering of ice and the temperature of the surface water in the Belt Sea in January and February on the other.

Another hydrographical factor which might be thought to influence the fluctuations in the number of fry in our inner waters is salinity. We will again commence here with studying the conditions in the lower water layers where the larvae principally occur. In the Table below is given the salinity of the bottom water at Halskov Rev Lightship in the months October—May together with the number of cod larvae fished in the Belt Sea during the years 1923—1929 in April and May:

Year	No. of larvae per ½ hour	Salinity at depth of 20 m. at Halskov Rev							
		Oct.	Nov.	Dec.[1])	Jan.	Feb.	Mar.	Apr.	May
1923	140	22.6	24.1	22.4	25.0	18.3	23.8	28.5	31.8
1924	2	22.8	17.8	17.2	18.0	24.0	27.3	26.5	30.1
1925	67	24.4	21.6	27.1	24.0	19.4	17.9	26.9	30.4
1926	5	22.4	18.4	20.4	19 7	25.0	26.4	27.0	26.8
1927	63	20.3	23.2	23.4	20.4	22.8	28.7	28.3	24.4
1928	25	21.6	17.2	22.8	23.4	24.2	24.3	29.0	30.3
1929	41	24.6	26.2	19.8	16.5	?	?	28.4	29.2

[1]) The previous year.

It will be seen from this Table that there is a distinct agreement between the fluctuations in the amount of fry and the fluctuations in salinity during the months November and December (and in a far less degree October and January) but not for any of the other months. The following Table in which the two months November and December are taken together shows this plainly. It is also shown in graphic form in Fig. 43.

Year	1923	1924	1925	1926	1927	1928	1929	Average
No. of larvae per ½ hour in April and May, Belt Sea	140	2	67	5	63	25	41	49
Salinity in Nov. & Dec. of previous year	23.3	17.5	24.4	19.4	23.3	20.0	23.0	21.6

It will be seen from the above that in the same years in which the number of larvae exceeded the normal (1923, 1925, and 1927) the salinity in the months in question has also been higher than normal, and in years when the salinity has been very low (1924 and 1926) the number of larvae has been very small; in 1928 when the salinity was only slightly under normal the number of larvae did not reach the normal figure but it was considerably greater than in the two unfavourable years 1924 and 1926. In 1929 the number of larvae was considerably higher than in 1928, and the salinity in the preceding months November and December were also considerably higher than in the previous year.

There are strong grounds for assuming, as has been already mentioned, that the years 1917, 1919, and 1921 were good survival years and the years 1918, 1920, and 1922 bad survival years; it will there-

fore be expedient to investigate whether there is also an agreement between the salinity and amount of fry in the years 1917—1922 similar to that observed in the period 1923—1929. We must here as in the case of the temperature use the observations from the Lightship at Schultz's Grund (26 m.). In the Table below the average salinity of the bottom water at Schultz's Grund during November and December throughout the period 1916—1928 is given together with the number of larvae caught per ½ hour in the Belt Sea in 1923—1929. The signs + or ÷ denote whether the year classes 1917—1922 were abundant or poor:

Year	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Abundance of year classes, Belt Sea	+	÷	+	÷	+	÷	140	2	67	5	63	25	41
Salinity per mille in Nov. & Dec. of of previous year	30.8	26.8	31.5	29.1	30.8	28.0	29.7	26.1	32.2	28.6	30.5	27.0	29.8

The above shows that also in the period 1917—1922 there was a distinct agreement between the variations in the number of fry and the fluctuations in the salinity of the bottom water in November and December so that a high salinity coincides with rich year classes in the following spring while a low salinity coincides with poor year classes.

A similar agreement can be established in the Kattegat despite the fact that the investigations there were not quite so comprehensive as in the Belt Sea.

In the Table below, which refers to the Kattegat, are given — in the same way as for the Belt Sea — the greater or less abundance of the different year classes compared with the average salinity of the bottom water in November and December of the previous year at the Lightships Læsø Trindel, Læsø Rende, Anholt Knob, and Schultz's Grund. The signs denoting the abundance or poverty of the year classes for the years 1919—1922 and 1928 are based on the catches with the tog given in Table 21, while for the years 1923—1927 and 1929 the average number of larvae caught per ½ hour in April and May are given.

Year	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Abundance of year classes, Kattegat	+	+(?)	+	÷	32	2	46	5	6	+(?)	23
Sal. per mille in Nov. & Dec. of previous year	31.7	31.1	31.4	31.2	31.8	30.1	32.2	29.7	31.1	30.1	31.2

Here again we find an agreement between the salinity in November and December and the number of fry in the following spring; but it is not quite so pronounced as in the Belt Sea.

The distinct agreement between the salinity in November and December and the number of fry in the following year, which is now established first and foremost for the Belt Sea and to a somewhat lesser extent for the Kattegat, cannot possibly be due to chance; we must assume a real connexion between the two phenomena.

How is it that there is this agreement? There can be no question here of any direct influence. Spawning does not begin until January and larvae are not found until the end of February.

First of all we must consider the possibility that the salinity in November and December has no influence at all on the number of larvae produced but that the agreement between these two phenomena arises from the fact that there is a positive correlation between the salinity in these months and the temperature in the following March, April, and May, and since there is an agreement between the bottom temperature in these months and the number of larvae there should thus be an agreement between the salinity in the months in question and the number of fry.

In order to investigate to what an extent there is such a positive correlation between the salinity in November and December and the temperature in March, April, and May I have correlated the average

salinity of the bottom water at Schultz's Grund in November and December with the average temperature of the bottom water at the same spot in the following March, April, and May for the period 1901—1929. This correlation proves to be 0.243 with a standard deviation of 0.141. The result arrived at thus shows that there may quite possibly be a certain connexion between the two phenomena, but the standard deviation is so large that the connexion cannot be considered as proved.

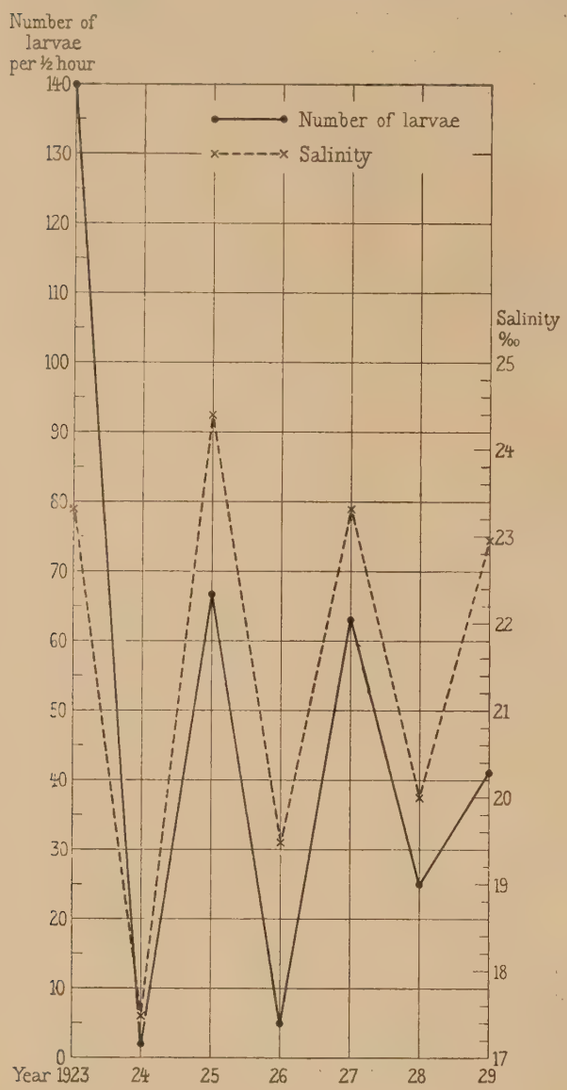

Fig. 43. Fluctuations in the number of cod larvae caught with a 2 metres ringtrawl per 30 minutes in the Belt Sea in the years 1923—1929 compared with the salinity of the bottom water at Halskov Rev light-vessel in the preceding November and December.

The possibility that the salinity in these months exerts a certain influence on the amount of fry in the following spring cannot be rejected. A high salinity in the Belt Sea and the southern Kattegat in November and December means that a comparatively great influx of salt water takes place in these months from the northern Kattegat and Skagerak.

As mentioned in Section IV, it is a generally accepted fact that in the autumn and winter a considerable immigration of large cod takes place into our inner waters.

Through experience gathered in the commercial fishery it can be established that in the autumn large cod migrate southwards in through the Sound and the Belts, and that these cod again emigrate in the course of winter and spring together with large cod of the stock which has grown up in these waters; but we do not know whether this emigration occurs before or after spawning.

There is reason to suppose that these migrations are connected with the yearly fluctuations in salinity. A. C. Johansen (1926) has shown that another fish of the cod species, the haddock, penetrates farther south into our waters when the salinity is particularly high than at other times.

Now at the very time when the cod immigrate, during the months August-December, the salinity rises in our inner waters (Martin Knudsen 1905). By current measurements carried out at the northern entrance into the Belt Sea (Schultz's Grund) and in the Sound during the years 1910—1916, J. P. Jacobsen (1925) has shown that the inflow is far stronger in November than in any other month, whilst the outflow is strongest in May. If the cod, as there is reason to suppose, is dependent in its migrations on the inflow and outflow we should expect immigration to occur chiefly in November and emigration in May. Marking experiments have not been sufficiently comprehensive to prove this and it now remains to be seen whether fishery statistics can do so.

Monthly statistics are issued for the Danish waters. Such statistics are for the years 1909 and 1910 published by A. C. Johansen and E. Neergaard Møller (1912 and 1913). For the year 1909 the average yield is given below in kg. per fishing day and per cutter using the Danish

seine in the Kattegat for each separate month after A. C. Johansen and E. Neergaard Møller, 1912, p. 82—83 and 1913 p. 146—151:

1909. Kattegat.

Month		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Cod in kg. per fishing day	Area A 0—20 m.	65	..	..	..	18	24	6	10	68
	— B 20—40 -	37	..	..	..	1	13	16	29	61
	— C 40—80 -	5	..	..	..	..	1	1	4	43

1910. Kattegat.

Month		Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Cod in kg. per fishing day	Area A 0—20 m.	251	207	31	2	0.2	0.1	..	..	2	34	87	354
	B 20—40 -	108	166	58	10	0.1	..	..	..	9	87	78	107
	— C 40—80 -	64	50	70	27	..	..	..	..	5			

1910. Belt Sea.

Month	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Cod in kg. per fishing day	731	383	657	17	..	..	..	..	..	63	82	488

Even though the very small catches in the summer months are due largely to the fact that cod in these months only fetch a low price, these Tables and especially the gradual decrease in the yield in March—May when cod still fetch a good price indicate nevertheless a real decrease in the density of the stock, whilst the gradual rise during the period Sep.—Oct.—Dec. indicates a real increase in the stock. According to this an increase in the stock should occur in Oct.—Dec. and a decrease in March—May, which indicates that immigration and emigration are affected to a certain degree by the hydrographical conditions, since as already mentioned the strongest inflow occurs in the autumn and the strongest outflow in the spring.

There can thus be scarcely any doubt that an immigration of large (and sexually mature) cod into our inner waters takes place in October, November, and December, and that emigration takes place in the course of March, April, and May. This autumn immigration is obviously connected, as mentioned above, with the autumn inflow of salt water.

The extremely distinct agreement between the number of fry in the spring and the salinity in November and December of the previous year may be brought about by the circumstance that in those very years when the salinity is high very many cod ready for spawning migrated into our inner waters; a particularly large number of eggs were spawned there which again resulted in a particularly large number of larvae developing. It is true that it has not been possible (p. 93) to demonstrate an agreement between the fluctuations in the amount of fry and the fluctuations in the quantity of eggs, but the investigations on eggs are not so comprehensive that we can be sure of their giving a completely valid picture of the annual fluctuations.

In the introductory remarks to this Section (p. 92) three more factors were mentioned which might be regarded as exerting an influence on the variations in the number of fry. The influence of marine currents on the drifting of eggs and larvae has already been dealt with in the literature on the subject. C. G. Joh. Petersen (1902) supposed that cod eggs and larvae were transported on a large scale by the current out through our waters and that the quite young bottom stages did not return into our inner waters until later in the summer. A. Otterstrøm (1906) arrives at the same conclusion; he writes (p. 26): "It has been shown p. 14 how these [the hydrographic conditions: currents] cause the

pelagic fish eggs and young to be carried from the intermediate parts of the Danish waters, partly out towards the North Sea, partly in towards the true Baltic. This must be the reason, why the Great Belt was quite empty of cod young in July, though in May the pelagic stages were not so few in numbers, also why the bottom-stages were absent from the southern Kattegat, Great Belt and the eastern part of the Western Baltic, but were present in the northern Kattegat and true Baltic." On the other hand J. P. JACOBSEN and A. C. JOHANSEN (1908) who investigated the distribution of the cod larvae in 1907 and 1908 are not of the opinion that large quantities of cod eggs and larvae are carried out of our inner waters by marine currents. They write (p. 24): "Thus it is our opinion, that the water movements in the Kattegat and Belt Sea are not unfavourable for an abundant presence of pelagic eggs and pelagic young of fishes in these waters."

PETERSEN's and OTTERSTRØM's supposition that cod eggs and larvae are carried out through our waters by marine currents is undoubtedly incorrect. As mentioned on p. 40, eggs and larvae are chiefly found in the lower water layers, i. e. in those water layers in which the main direction of the current is southwards into our waters, whilst the upper layers where the current in general flows northwards are poor in eggs and larvae.

We possess further several clear proofs that at times considerable quantities of fish larvae can be brought into our waters by ingoing currents. It is thus a well-known fact that the haddock does not spawn in the Belt Sea or the Western Baltic, but in certain years haddock fry have none the less been observed in quite appreciable quantities. These haddock fry have appeared in the Belt Sea simultaneously with or immediately after a strong influx of salt water from the north. Thus in 1923 (A. C. JOHANSEN 1926) a strong influx of salt water took place in April, May, and June into the Belt Sea and Western Baltic, upon which the salinity rose c. 4 per mille; at the same time haddock larvae were observed both in the Belt Sea and the Western Baltic. Similarly in June and July 1928 (ERIK M. POULSEN 1928) an unusually strong influx of salt water occurred (the salinity rose to c. 4—5 per mille above normal), and at the same time haddock larvae and young bottom stages were observed in the Belt Sea and Western Baltic.

As the larvae of haddock and cod are found in the same water layers and lead the same kind of existence, it may be regarded as certain that in 1923 together with the haddock larvae the cod larvae must also have been brought in with the current, and that in 1928 together with the haddock fry of the bottom stages a number of cod of the 0-Group must also have entered the Belt Sea. The results from the fishing experiments also indicate that cod fry have thus drifted in. In 1923 unusually large numbers of cod fry were found in the Belt Sea and Western Baltic in June, far larger numbers than have ever been observed either before or after (see Table 11). Also in the summer of 1928 cod fry have probably drifted in at the same time as the haddock fry. If we consider the curves in Fig. 41 we shall see that the 0-Gr. in this summer were more numerous than was to be expected from the number of larvae observed in the spring. From 1927 till 1928 the curve showing the number of larvae falls abruptly, whereas the curve for the 0-Gr. only sinks quite inconsiderably. This may be due to the figure for the 0-Gr. in 1927 being too low (as mentioned on p. 88), but it may also mean that a number of individuals of the 0-Gr. were brought into the Belt Sea during the summer of 1928 from outside.

The two instances given here make it probable that we must in some measure reckon with considerable numbers of cod fry (older larvae or bottom stages of the 0-Gr.) being brought into the Belt Sea and the Western Baltic — and presumably also the southern portions of the Kattegat — when a strong inflow of salt water takes place in the spring or early summer.

The question as to what influence the attacks of enemies have on the amount of fry can from its very nature only be answered very inadequately. It is certain that many larvae are destroyed by Ctenophores (*Pleurobrachia* etc.). During fishing operations with the young fish trawl *Pleurobrachia* is often caught with a cod larvae in the "stomach"; if we consider the large numbers of *Pleurobrachia* which may occur in

the late spring months in our inner waters we shall understand how considerable numbers of tiny cod larvae can be destroyed by these Ctenophores. *Pleurobrachia* lives in relatively salt water and thus is liable to be most destructive in summers when salt water flows copiously into our waters, i. e. at the same time that cod larvae are brought in by the currents.

X. The Yield of the Cod Fishery in Danish Waters during the Years 1905—1928.

In the preceding Section we have sought to form some idea from the material collected at the scientific fishing experiments as to the fluctuations in the number of cod larvae and older individuals of the 0-Gr., I-Gr., II-Gr., etc. and we have seen how these fluctuations are caused by fluctuations from year to year in certain hydrographical conditions. In the following we shall consider the fluctuations in the cod stock as a whole, as they become apparent to us in the yield of the commercial fishery.

1. Statistical Summary.

By means of the official fishery statistics published in the "Fiskeri Beretning" we are enabled to follow the fluctuations in the fishery yield.

Table 22. Yield in tons of the Danish Cod-fishery in the years 1905—1928. After „Fiskeri-Beretning".

Year	North Sea	Skagerak	The Limfjord	Kattegat	The Sound	Belt Sea[1] [2]	Western Baltic[2]	Baltic proper	Total	Price Øre pr. kg
1905....	529	422	875	1405	..	2640	..	211	6082	.
1906....	422	642	507	1827	..	2170	..	105	5673	..
1907....	1033	714	466	2430	..	1957	..	322	6922	..
1908....	698	633	415	2128	..	1966	..	503	6343	..
1909....	718	1017	445	1203	406	2366	64	1119	7274	.
1910....	807	899	510	2545	554	3201	81	793	9416	..
1911....	1068	925	585	2823	713	3520	85	428	10150	19
1912....	1330	769	627	2534	882	4080	76	423	10760	19
1913....	1049	1377	197	3230	715	2919	113	422	10030	20
1914....	1426	1175	99	3335	403	2496	66	622	9633	23
1915....	3178	1497	89	3797	583	3371	134	1226	13779	29
1916....	2966	1869	63	4217	748	3992	187	766	14807	59
1917....	1582	1348	175	2930	606	3648	154	311	10755	49
1918....	3800	1434	298	2545	730	4435	302	253	13797	54
1919....	2585	1741	1147	4059	1755	6360	321	570	18538	48
1920....	1359	1316	738	4822	1227	(6341) 6575	(201) 331	944	17358	42
1921....	1045	1276	772	4073	1144	(5777) 6010	(154) 323	743	17423	33
1922....	824	1222	860	4412	1115	(4873) 5056	(162) 272	639	14759	24
1923....	1198	1473	246	5633	1375	(5448) 5793	(138) 252	663	16742	26
1924....	1625	1097	94	5543	1156	(4806) 5064	(225) 348	1021	16163	33
1925....	2080	1198	88	5778	1315	(5782) 6110	(232) 368	1101	18301	30
1926....	2176	1342	50	6102	1351	(7075) 7542	(275) 593	1343	20761	21
1927....	3543	2173	73	6092	1531	(7016) 7576	(293) 460	1174	22823	18
1928....	3205	2197	47	6235	1492	(8530) 8801	(395) 681	1226	23886	19

[1]) For the years 1905—1908 the yield from the Sound and the Western Baltic are included in the yield of the Belt Sea.

[2]) For the years after 1920 (the reunion) is the yield excluding the catch from North-Slesvig stated in brackets for the sake of comparison with the yield before that year.

In Table 22 are shown the variations in the yield of the Danish cod fishery during the years 1905—1928. We see from this that the yield has risen very considerably in this period. During the years 1905—1909 the average yield was 6.459 tons, in 1910—1913 10.089 tons, in 1918—1922 16.375 tons, and in 1923—1926 as much as c. 17.992 tons. In the last years 1927 and 1928 the yield has been 22.823 and 23.886 tons respectively.

The increase in the yield has not been uniform throughout our waters. We see at once from the Table that up to 1927 it was comparatively small in the waters outside the Skaw but very great in the inner waters. In 1927 and 1928 on the other hand the increase was extremely great in the North Sea while in the other waters it was more steady.

The main yield of the cod fishery in the different Danish waters (with the exception of the Limfjord) during the four-year periods 1911—1914, 1921—1924, and 1925—1928 is given in the Table below together with the percentage of the increase in the yield:

Area	1911—1914	1921—1924 (increase per cent)	1925—1928 (increase per cent)
North Sea	1218 tons	1173 tons (÷ 4 %)	2751 tons (126 %)
Skagerak	1062 —	1267 — (19 %)	1728 — (63 %)
Kattegat	2991 —	4915 — (64 %)	6052 — (102 %)
The Sound	678 —	1198 — (77 %)	1422 — (110 %)
Belt Sea[1])	3254 —	5226 — (61 %)	7101 — (112 %)
Western Baltic[1])	85 —	167 — (96 %)	299 — (252 %)
Baltic proper	474 —	767 — (62 %)	1211 — (156 %)

The yield of the cod fisheries throughout the Danish waters taken together has rather more than doubled. The increase has been least in the Skagerak and greatest in the Western Baltic. Furthermore it will be seen that in 1921—1924 there was still no increase in the North Sea, and in the Skagerak it was only slight (19 %). In the waters within the Skaw on the other hand the increase was already considerable, between 60 % and 100 %.

2. Has the Quantity of Cod in Danish Waters increased during the Years 1905—1928?

When we are faced with such a considerable increase in a fishery yield as this which has occurred in the Danish cod fishery, especially in the waters within the Skaw, the question very naturally arises: is this increase in the yield due to an augmented intensity in fishing or has a real increase in the cod stock taken place in our waters?

A. C. Strubberg (1922) calls attention to the increase in the cod fishery yield which occurred in 1905—1919, and he is of the opinion that it was due in great measure to the steady development in fishery technique; he does not however reject the possibility that also other factors — independent of the fishery — are involved, but he says nothing as to the degree and manner in which they operate. The extremely large increase in the years subsequent to 1919 lends the greatest importance to this question.

It is undoubtedly correct that the constant improvements in the vessels and implements which were made in the first 14 years of the present century have contributed towards increasing the yield of the cod fisheries — and also of our other fisheries. The gradual adoption of motor power which took place during this period must be reckoned as an important cause of the increased fishery. An

[1]) In the years 1921—1928 for the sake of comparability the waters are not included which adjoin those parts of South Jutland which were reunited to Denmark in 1920.

Table 23. Number of Fishing Implements employed in the cod fishery in various Danish waters in the years 1912—1928.

Year	North Sea				Skagerak				Kattegat				Sound				Belt Sea				Western Baltic				Baltic proper			
	Cod weels	Danish seine	Otter seine	Lines (100 hooks each)	Cod weels	Danish seine	Otter seine	Lines (100 hooks each)	Cod weels	Danish seine	Otter seine	Lines (100 hooks each)	Cod weels	Danish seine	Otter seine	Lines (100 hooks each)	Cod weels	Danish seine	Otter seine	Lines (100 hooks each)	Cod weels	Danish seine	Otter seine	Lines (100 hooks each)	Cod weels	Danish seine	Otter seine	Lines (100 hooks each)
1912	..	510	..	74097	..	231	1	15860	7311	1996	3	28869	838	73	..	5830	41493	527	441	19865	375	..	52	1423	40	1	56	4940
1913	..	569	174	85401	..	214	1	14900	6910	1985	4	26102	670	71	..	5830	38162	479	774	22339	349	..	48	2060	90	2	61	3870
1914	6	631	202	86541	..	201	1	13510	7225	2059	16	30575	551	72	..	8375	38036	476	742	18958	90	..	39	2630	20	5	59	4895
1915	4	1087	174	76678	5	177	1	20610	6517	2054	35	18530	535	62	2	5995	38223	457	801	25408	235	..	47	2880	..	3	70	5970
1916	8	1499	233	96976	3	141	2	21740	7868	1883	73	18655	485	72	5	5200	41925	311	863	21639	157	..	54	3785	10	3	32	4780
1917	137	1912	273	74887	..	146	3	21008	5796	2146	89	24113	990	70	8	5140	43219	305	813	18984	340	..	60	3730	106	6	92	4645
1918	4	2368	318	91733	..	133	3	32158	4913	2103	103	19446	835	62	6	5815	36746	267	874	17607	402	..	70	1908	120	..	81	5450
1919	32	2343	258	94865	..	140	3	16070	5184	2259	237	21015	448	74	11	9195	36795	312	1219	18603	387	..	78	2510	20	2	94	5860
1920	15	1972	238	91750	48	147	3	23788	4349	2345	238	20544	505	92	11	5903	43364	351	1188	20943	1851	1	126	2495	110	4	89	5790
1921	..	1882	242	88377	48	139	2	29440	4854	2179	190	25758	470	105	12	6450	40206	331	1226	17097	1298	3	137	2755	50	10	98	7690
1922	12	2125	221	91890	..	157	2	17840	5070	2396	234	25390	526	103	13	8495	35227	325	1521	15911	1542	2	160	2460	90	24	103	7525
1923	10	2102	210	96122	..	143	2	18190	5260	2377	205	28561	670	104	24	8135	31832	321	1354	14454	1497	4	163	1995	100	96	169	7195
1924	10	2017	105	90900	..	117	.	15875	4686	2431	186	27297	742	92	36	6915	29244	306	1348	17761	1477	7	175	2295	170	112	422	7810
1925	10	1998	100	95506	..	119	.	15475	4341	2517	193	28502	446	104	34	6675	26528	316	1397	18426	1464	6	179	2145	110	110	558	10076
1926	10	2082	107	93812	..	132	.	16025	3596	2537	248	29855	590	103	37	10775	26576	302	1386	18845	1327	13	177	2147	150	104	604	16865
1927	..	2143	109	92960	..	129	1	15722	2965	2704	242	32325	580	103	28	7865	24394	350	1363	18211	1084	7	179	2170	40	100	620	9955
1928	6	2215	123	95510	..	112	1	19200	2521	2893	265	35830	320	92	21	7545	20859	373	1377	19392	1022	5	176	2230	40	95	622	14472

increase in the fishery yield can also be regarded as a consequence of the rise in the number of fishing implements. Aage J. C. Jensen (1929, p. 4) writes on the question of a connexion between the number of implements and the yield: "that the number of fishing implements has not varied correspondingly with the fishery yield, and it cannot be the principal cause of the variations in the latter". He is of the opinion that the variations from year to year in the fishery yield in the waters within the Skaw are mainly due to variations in the quantity of cod in these waters. If we consider Table 23, which shows the number of fishing implements in the different waters in the years 1912—1928, we see that the number of weels is evidently declining everywhere in our waters, whilst the number of Danish seines and otter seines is rising. The number of lines is increasing in the Baltic proper but is otherwise fairly constant. It is however very difficult if not impossible to draw conclusions from this list of implements as to the variations in the intensity of the cod fishery in the course of years, firstly because it is quite possible that implements may have been listed in the fishery statistics in a given year without their having been employed in that year, secondly because we have no data of any kind whatever showing how much the different implements have been employed, and thirdly because we have no even approximately accurate information as to the relative efficacy of the different implements as regards catching cod and thus cannot judge whether, or to what an extent, a decrease in the number of weels may be counterbalanced by an increase in the number of Danish seines and otter seines. For these reasons it is undoubtedly too venturesome to use a lack of agreement between the variations in the yield and those in the number of fishing implements as a proof that it is not the intensity of fishing which has determined the rise in the fishery yield. To include the price in øre per kilogram as an additional factor for the purpose of throwing light on the intensity of fishing, as Aage J. C. Jensen does, is a step in the right direction; however the price of cod too is no measure of the intensity of fishing. An important factor regulating

the intensity of fishing for a given species of fish is the price fetched by this fish in relation to the price fetched by the most important of the other fish in the waters in question. When it is impossible to obtain an accurate and direct determination of the intensity of fishing by giving the degree with which an area is fished by the different implements, together with a fairly reliable impression of the efficacy of the different implements as regards catching the species of fish in question, we can scarcely turn to a better means for estimating the intensity of fishing a given species of fish than its price in relation to the prices of the other important species of fish.

If we now compare the prices fetched by cod in recent years with the prices of our other marketable fish, we see clearly that it is quite impossible for the prices to have tended to bring about an increased intensity in the cod fishery; they are far more likely to have had a restraining effect.

During the periods 1917—1919 and 1925—1927 our most important species of fish fetched namely the following mean price in øre per kilogram for all Danish waters:

	Mean Price 1917—1919	Mean Price 1925—1927	Price reduction in øre	Price reduction per cent
Plaice	79	70	9	11
Silver eel	238	181	57	24
Herring	48	27	21	44
Mackerel	58	30	28	48
Haddock	48	42	6	13
Cod	50	23	27	54

We see that cod is the fish whose price has sunk the most, herring and mackerel having also been reduced strongly in price, but not so much as the cod. The silver-eel on the other hand has only been reduced by 24 %, the plaice and haddock by no more than 11 % and 13 % respectively. The alteration in the relative prices of the different species of fish thus cannot possibly have had a stimulating effect on the intensity of the cod fishery; one must rather assume that the prices have caused the fishermen to transfer their attention to other fish. Another circumstance which tends to indicate that the intensity of the cod fishery is declining is that in recent years one has often heard fishermen complain that their implements became so full of cod that their power in catching other fish was considerably decreased. How little interest the fishermen have taken in cod can also be seen from the fact that one occasionally hears that they have thrown the cod back into the sea without bringing them to land.

Another clear proof that cod have lost a much greater proportion of their value than the bulk of the other species of fish is the fact that whereas the cod fishery yield in 1919 constituted 16 % of the total yield in terms of value and 21 % of the total yield by weight, the value percentage had fallen in 1926 to 12 % while the weight percentage had risen to 27 %. The corresponding percentages in 1928 were 13 and 25.

Everything taken together, the facts set forth above show that it is not the intensity of fishing which has led to the increased cod fishery yield, and the latter then must be due to the cod stock in our waters — especially in the waters within the Skaw — having become considerably larger.

Not merely the fishery statistics but also the scientific fishing experiments prove that the cod stock in our inner waters has increased.

A series of hauls were made with the trawl in our waters from the "Thor" in the years 1903— 1907, and in the years 1922—1927 hauls were made from the "Dana" with a trawl of the same size and type as that used on the "Thor" in 1903—1907. The results of the trawlings in these two periods are given in the Table below:

Period	1903—1907		1922—1926 (27)[1])	
Area	No. of cod per trawling hour	No. of trawling hours	No. of cod per trawling hour	No. of trawling hours
North Sea	13.5	298	7.0	71
Skagerak	4.2	240	2.7	25
Kattegat	4.2	501	13.4	17
The Sound	1.5	6	..	0
Belt Sea	0.8	13	18.9	10
Western Baltic	0.9	4	12.0	3
Baltic proper	1.2	34	32.1	17
All waters	6.6	1093	11.0	143

As the above figures show, the number of cod caught per trawling hour in the North Sea and Skagerak was considerably smaller in the period 1922—1927 than in the period 1903—1907, whilst the number in our inner waters was far greater in the former than the latter period. Even though the number of trawling hours was fairly small in some cases, the similarity in the fluctuations — a fall for the North Sea and Skagerak and a rise for all the inner waters — nevertheless shows that we are justified in drawing conclusions as to the density of the stock in the two periods.

If we compare the results arrived at by the fishing experiments with the figures of the fishery statistics (taken from the Fiskeri-Beretning) we see that in the North Sea and Skagerak, where the rise in the yield has only been small right up till the year 1927, fewer cod were found at the fishing experiments in 1922—1927 than in 1903—1907.

In the case of the eastern part of the North Sea and the southern Skagerak both the fishery statictics and the results of the fishing experiments up till 1926 (27) tend to show that the cod stock in these waters did not increase in the years under investigation.

It cannot yet be decided whether the great rise in the fishery yield in these waters in 1927 and 1928 was due to an increase in the stock of fish or whether it is to be ascribed to an increased intensity in fishing. There is however reason to suppose that the sea fishery with the Danish seine in the North Sea which has been so considerably developed has brought about an increase in the intensity of fishing not only as regards the haddock but also as to the cod. In any case part of the increase in the yield can undoubtedly be ascribed to an increased intensity of fishing.

Whilst the question as to the reduction or expansion of the cod stock in the eastern North Sea and southern Skagerak is thus somewhat doubtful, in our inner waters the matter is clear. Here there is both an extremely great rise in the yield and a considerable increase in the number of cod caught per trawling hour. These two phenomena which point in the same direction signify that in our inner waters from the Kattegat through the Belt Sea into the Baltic the cod stock has increased, so that in recent years (at all events after 1922) it has been considerably larger than for a number of years previous to 1914.

XI. The Causes of the Increase in the Cod Stock.

An increased fish stock is in our days a rare phenomenon. One is far more often faced with a decrease in a stock of fish; this has taken place in the case of plaice throughout all our inner waters, of turbot in the Bornholm waters, and of flounders in the Western Baltic and the Baltic proper. Investigations into the cause of the diminution of a stock have in fact often been carried out, and the result has been reached that it generally is due to an intensive fishery. It would therefore be natural to suppose that

[1]) In 1927 trawling operations were only carried out in the Horn's Reef Area and only for 3 hours in all.

in the case here in question — the increase in the cod stock — the cause was a diminishing intensity of the fishery. As shown in the preceding Section, the fluctuations in price between the cod and our other marketable fishes indicate to some extent that the intensity in fishing for cod has diminished. From Table 22 however we see that the prices of cod did not begin to fall until the years 1919—1921. The intensity of fishing, which depends — as emphasised in the preceding Sections — to a considerable degree on the price, therefore probably began to decrease in the years 1919—1921. The great rise in the yield of the cod fishery began however already in 1919, and it cannot therefore be ascribed to the diminution in the intensity of fishing. It is more likely that the relation between price, intensity of fishing, and stock is such that an increased stock, has caused an increased yield, which depresses the prices and thereby again has caused a decrease in the intensity of fishing. The decreasing intensity of fishing is thus a consequence of the increased stock, and the causes of the latter must therefore be sought for outside the direct effects of the fishery.

The following factors may be regarded as possible causes of an increase in the cod stock:

1. More abundant production of larvae.
2. More favourable conditions for the thriving of larvae.
3. More abundant food for the fry after they have attained the bottom stage and later during their upgrowth.
4. More extensive immigration from other waters and less extensive emigration into other waters.
5. Diminution in the attacks of enemies.

It has been shown in Section VIII that the number of individuals in the year classes which are the object of fishing operations is dependent on the number of larvae which were present in those years when these year classes came into being, and in Section IX it has been shown that there are more larvae in springs when the bottom water is comparatively warm than in springs when the bottom water is colder. It is of interest in this connexion that Aage J. C. Jensen (1929) has shown the existence of a positive correlation between the yield of the fishery in one year and the temperature of the bottom water in the spring 3, 4, and 5 years before. He deduces from this that comparatively many larvae are produced in those springs when the water is comparatively warm in the spring months. The direct connexion which has been observed (p. 104) between the amount of fry and the temperature of the bottom water proves the accuracy of this deduction. Moreover Aage J. C. Jensen points out that the average temperature of the bottom water in the spring months has been higher in the last 10—12 years than in the preceding years (back to 1903). He says nothing however as to whether this increase in temperature could have caused the increase observed in the cod stock.

The columns below giving the mean temperature of the bottom water at Schultz's Grund Lightship in the spring months of the years 1900—1929 show that during the years 1900—1914 there was only 1 year

1900 — 3.8°	1905 — 3.8°	1910 — 4.2°	1915 — 5.0°	1920 — 3.6°	1925 — 5.2°
1901 — 4.6°	1906 — 3.5°	1911 — 4.4°	1916 — 4.5°	1921 — 4.9°	1926 — 4.8°
1902 — 4.4°	1907 — 3.8°	1912 — 4.7°	1917 — 5.4°	1922 — 5.2°	1927 — 5.3°
1903 — 3.8°	1908 — 3.9°	1913 — 4.2°	1918 — 3.3°	1923 — 5.4°	1928 — 4.2°
1904 — 4.8°	1909 — 5.0°	1914 — 4.9°	1919 — 5.9°	1924 — 4.0°	1929 — 4.5°

Mean for all years 4.5°C.

in which the temperature was 0.5°C. above normal, whilst during the years 1915—1921 there were no less than 7 years in which it was 0.5°C. or more above normal.

The rise in the yield of cod fishery in our inner waters has been particularly pronounced since 1919, and in the period when the year classes were produced which brought about this rise there were

comparatively many years when the temperatures were high and in which the number of larvae produced must thus have been particularly large. It is therefore natural to suppose that one of the reasons for the increase in the cod stock has been the improved conditions for the production and thriving of the larvae.

I have not been able to investigate directly whether in recent years, in which the cod stock has greatly increased, there has been more food or less for the upgrowing cod than in former years, since I have had no quantitative investigations on bottom animals at disposal. But indirectly, by investigating the fluctuations in the frequency of the species of fish which compete with the cod for food, we shall be able to form some idea whether there have been more favourable food conditions for the cod in our inner waters in recent years than for a number of years prior to 1914. In Section VII an account has been given of the food of cod. It has been shown that, among the somewhat larger individuals of the 0-Gr. (10—15 cm.), worms (*Nephthys* etc.) and crustaceans (Gammarids, Mysids, etc.) constitute the chief part of the stomach contents. Among cod of between 15 cm. and 30 cm. in length, annelids, crustaceans, and small fish constitute the most common food. In the stomachs of the medium cod (30—50 cm.) are found considerable quantities of small fish, crustaceans, worms, and in certain cases *Abra alba*. The large cod consume chiefly crustaceans and fish. The question is now whether some of the above-mentioned food animals constitute a considerable part of the food of others of our common fish. The fish which will here be taken into account first and foremost are those which seek their food on or near the bottom, i. e. the plaice, flounder, dab, and eel.

Through H. Blegvad's close investigations into the food of fishes in the Danish waters within the Skaw we are well acquainted with the food of several of our most important species of fish. I have given below, on the basis of H. Blegvad's lists, a table showing the food of plaice, flounders, dabs, and eels in our inner waters (including the Limfjord). The figures represent the stomach contents in grams, and the approximate proportion which each food group constitutes of the total stomach contents. The number of the fish examined is given in brackets:

	Plaice	Flounders	Dabs	Eels
Molluscs	9141 — 2/3	1317 — 3/5	1376 — 1/3	624 — 1/3
Annelids	3323 — 1/3	418 — 1/5	778 — 1/5	474 — 1/5
Crustaceans	202	258 — 1/10	427 — 1/9	539 — 1/3
Other stomach contents	11	38	1089	356 — 1/6
Total stomach contents in grams	12677 (2515)	2031 (258)	3670 (1482)	1993 (614)

Molluscs are of little importance as food for cod, whereas annelids, crustaceans, and fish are of great importance. The Table above shows that these groups (annelids, crustaceans, and fish), which are of great importance for cod, constitute 1/3 of the food of plaice, 1/5 of the food of flounders and dabs, and 2/3 of the food of eels. The eel and plaice thus live in great measure on the same food as the youngest age groups of cod. Assuming that the stock of fish in our inner waters is so dense that it attacks the food animals so intensively that their numbers are diminished to an extent which severely affects the fish, the competition of the plaice and eel may thus have a restraining influence on the growth of the cod. There are several facts which indicate that such a severe attack has taken place on the food animals during the series of years here investigated. In our inner waters the growth of the plaice has proved to be better after the stock has been thinned out by the fishery. This is shown clearly by C. G. Joh. Petersen's table[1]) of the mean lengths of various age groups of plaice during the years 1905—1909 and in 1921 (Table 1, 1922). In the Kattegat, the mean lengths of the II-Gr. and III-Gr. in

[1]) According to measurements from the Danish Biological Station, and A. C. Johansen (1906 and 1912). and Reibisch (1911).

1921 were c. 4—7 cm. and c. 9 cm. respectively larger than in 1905; in the Belt Sea there was a similar difference in size, and in the Western Baltic the difference in size was c. 10—14 cm. Strodtmann and Langhammer (1925) have made similar observations.

The quantity of food available for the bottom fish in our inner waters is thus by no means so abundant that a competition for food among the different fish is out of the question. There is thus reason to suppose that a decrease in the size of the stock of plaice and eels cause more favourable food conditions for their competitors, i. e. for the youngest age groups of the cod. If we now compare the mean yield of the plaice and yellow eel fisheries in 1910—1914, with the mean yield in 1920—1924 in the Kattegat, Sound, Belt Sea, and the Western Baltic, as is done in the table below, we see that the yield of the plaice fishery has been reduced by one fourth, and the yield of the yellow eel fishery by one

Year	1910—14	1920—24
Plaice	5167 tons	3857 tons
Yellow eel	1654 —	889 —

half. A decrease in the yield of two species of fish so much in demand by fishermen as the plaice and yellow eel can be looked upon as a true expression for a decrease in the density of the stock; as regards the plaice this decrease in the density of the stock is further proved by the scientific fishing experiments. Owing to the competition for food shown to exist between plaice, yellow ells, and cod we can with good reason assume that the decrease observed in the stocks of plaice and yellow eels has brought about more favourable food conditions for the cod and thereby contributed towards the formation of the particularly large cod stock which we have had in our inner waters in the last decennary.

In Section IV it has been mentioned that the cod undertake extensive migrations in our waters, and it has been shown how the immigration of the younger age groups may involve considerable numbers of individuals. It has also been mentioned (p. 100) that larvae drift into our inner waters from outside in considerable quantities. It should further be mentioned in this connexion that (see p. 99) large cod immigrate in autumn into the Belt Sea, and finally it has been shown to be probable (in Section IX) that the number of large cod which immigrate depends on the strength of the influx of salt water in the last two months of the year.

This immigration, both of young and older fish, and the drifting-in of larvae is obviously (see p. 20) of considerable importance for the maintenance of the cod stock in our inner waters, and there is thus reason to investigate whether the salinity in the last decennary has been such that there is a possibility of the numbers of the cod and larvae, which have immigrated and drifted in, having been larger in recent years than in the years prior to 1914.

It has been already mentioned (p. 100) that in the early summer of 1923 there occurred an unusually strong influx of salt water, and in June of the same year particularly large numbers of cod larvae were observed in the Belt Sea and Western Baltic. Haddock larvae were also shown to have drifted in at the same time (A. C. Johansen 1926). It is therefore probable that the large number of cod larvae were largely due to their having drifted in with the salt under-current. There is therefore reason to investigate whether a particularly strong influx of salt water in April, May, and June has occurred more frequently in recent years than in the years prior to 1914. The figures in the table below, which has been compiled from the observations of the salinity of the bottom water at the Schultz's Grund Lightship in 1901—1928, show that in April there was a salinity of 0.5 per mille or more above normal in only 6 years throughout the period 1901—1914, but in no less than 12 years throughout the period 1915—1928. In May the salinity was 0.5 per mille or more above normal in 7 years in each period. In June it was 0.5 per mille above normal in 5 years during the period 1904—1914 and in 8 years during the period 1915—1928. In April the mean salinity was considerably higher in the period 1915—1928 than

Number of years in which the salinity was 0.5 per mille or more above normal:

		in April	in May	in June
	1901—1914	6	7	5
	1915—1928	12	7	8
Mean salinity	1901—1914	30.9 ‰	32.3 ‰	32.5 ‰
	1915—1928	32.3 ‰	32.5 ‰	32.5 ‰
	1901—1928	31.6 ‰	32.4 ‰	32.5 ‰

in the period 1901—1914. In the two other months it was about the same in each period. The figures in the above table thus indicate that at all events in April the hydrographical conditions were more favourable for the drifting-in of cod larvae in the period 1915—1928 than in the period 1901—1914.

From the results of the investigations we can assume that the larger cod immigrate in the last half of the year. An investigation of the salinity during the months July-December in the periods 1901—1914 and 1915—1928 do not however show more favourable conditions for immigration in the latter period than in the former.

The investigations undertaken here into the causes of the increase in the cod stock thus tend to show that the chief cause of the increase in the stock has been the comparatively high temperatures of the bottom water in those months in which the larvae mainly occur, whilst more favourable food conditions for the upgrowing cod, and more favourable conditions (relatively high salinity) for the drifting-in of larvae and young bottom stages of the 0-Group may be given as contributory causes.

Summary.

The cod occurs throughout the Danish waters, and it penetrates a fairly long distance into the brackish Baltic, only in the northernmost part of the Gulf of Bothnia between Uleå and Luleå is it not found.

The cod is fished nearly everywhere in the Danish waters, the yield of the fishery being largest in the Kattegat and the Belt Sea.

The Tables 1, 2 and 3 and the Charts Figs. 1—4 show the distribution of the cod in the Danish waters on the basis of scientific fishing experiments with trawl and tog. Though the fact that the cod to some extent is a shoal fish may, in some degree, disturb the general view of its distribution, we can from the charts and especially from the tables see that in the North Sea it is most commonly found in depths of less than 100 metres. Between 100—200 m. it is scarce, and in deeper water than 200 m. but few cod are caught. It is only the larger and older cod which enter the deeper waters. In the Kattegat the cod is most numerous at intermediate depths between 20 to 60 metres. In the Baltic around Bornholm the cod descends to the greatest depths occurring there (c. 100 m.); it occurs here most frequently in the salter water below 40 m.

A number of racial analyses have been carried out: the vertebrae of 834 and the rays in the second dorsal fin of 1267 individuals having been counted. In the North Sea and the northernmost part of the Kattegat the mean number of vertebrae is 52.10, and in the southern Kattegat and the Belt Sea it varies between 51.60 and 51.80. The mean number of rays in the second dorsal fin is in a sample from the North Sea 18.91, in the Kattegat it varies between 17.73 and 18.64, and in the waters around Bornholm two samples show 17.50 in mean. The difference between the number of rays for the North Sea and the Baltic is so great that we are justified in assuming that there is another race of cod in the Baltic than in the North Sea.

A closer examination of the racial characters in relation to the different age groups gives us an explanation of the intermediate and rather varying values found in the southern Kattegat and the Belt Sea as well as evidence regarding the migrations of the cod. In Table 4 are given the mean numbers of rays and vertebrae of the different age groups of cod. From the table it will be seen that in the southern Kattegat, the Belt Sea and the Baltic the number of rays increases from the younger to the older age groups; in the Belt Sea the mean number of the 0-Gr. is 17.73 and that of the IV-Gr. not less than 18.52. In the Baltic the number of rays in the III-Gr. is 17.26 and in the IV-Gr. 17.47. This increase clearly shows that cod from the North Sea, the Skagerak and the northern Kattegat to a large extent immigrate to the Belt Sea and the Baltic. A calculation (see p. 20) of the degree of the immigration on the basis of the mean numbers of rays indicates that of the IV-Gr. in the Baltic one third and in the Belt Sea more than the half has immigrated from outside. The immigration thus is so great that is plays an important part in the renewal of the stock of cod in these waters.

The spawning of the cod in our waters is elucidated partly through vertical hauls with the Hensen net and partly through examinations of the stage of maturity. In the Figs. 6—14 the numbers of cod

eggs caught per square meter surface in bottom-surface hauls with the Hensen net in the years 1923—29 are stated, and the Tables 6 and 7 give the mean number of eggs caught in different waters in different months, and in Table 8 are given the observations of the stage of maturity. In the Kattegat spawning is in full swing in March and also in February, it here ceases by the end of April. In the Belt Sea the chief spawning season is March, and the spawning ends in late April or the first half of May. In the Western Baltic the chief spawning occurs in March or April and in the waters east of Möen and Falster spawning still occurs to some degree in May. In the Bornholm Deep spawning takes place from April to August, June may here be said to be the chief spawning month.

A comparison between the temperature of the bottom water and the spawning season throughout our waters show that the main spawning occurs in water between 3°—7° C, and the displacement in the spawning season throughout our waters from the winter through the spring and far into the summer, as we proceed from the Kattegat to the Baltic, corresponds with the different times at which the bottom water reaches this temperature.

In most of our waters the cod eggs are found outside the 20-metre line in the lower water layers from the bottom up to the more brackish surface layer. At Bornholm however cod eggs are chiefly found in still deeper water outside the 50-metre line; this is evidently owing to the fact that the upper water layers in the late spawning time (June) are rather warm (Table 10). In the lowest water layer in the Bornholm Deep no cod eggs or practically none are found, this undoubtedly being due to the small content of oxygen (Table 14).

The occurrence and distribution of the cod larvae are investigated through fishing experiments with the stramin ring trawl or Petersen's young fish trawl. The Figs. 15—24 illustrate the distribution of the larvae throughout our waters. In Table 11 the number of larvae caught per 30 minutes' haul in the different months in the years 1923—29 are stated. The larvae occur through the whole of the area investigated. They are most numerous in the North Sea, the southwestern Kattegat, the Sound, Belts and Western Baltic, being scarcer in the Skagerak, the northeastern Kattegat and the Baltic proper. They are found in the greatest quantities in the lower water layers (at depths more than 12 metres), being less numerous in the surface layers. The deepest parts of the waters round Denmark form an exception to this rule, i. e. the Skagerak outside the 100 m. line (Fig. 20) and the Baltic outside the 80 m. line (Table 12). In the deepest part of the Bornholm Deep the quantity of oxygen is very low, 1—5 ccm. per liter, and it is no doubt this low oxygen content which keeps the cod larvae away from the deep portions of the Bornholm Deep. The reason why the cod larvae are lacking in the deeper parts of the Skagerak is undoubtedly the very little amount of food in these water layers, see Fig. 20. By examining the frequency of the cod larvae in our waters we find that in front of the ridges which dam up for the ingoing currents in the Little Belt, at Gedser Reef, and at Drogden in the Sound, we find that the larvae are very abundant, whilst behind these ridges they are rather scarce. The hydrographic observations show that the ingoing salt water currents to a great extent stop at these ridges. The cause of the abundance of larvae in front of these ridges then obviously is that they are dammed up together with the ingoing water and accordingly must to a certain degree accumulate here. This too explains the sudden paucity of cod larvae behind these ridges, and at the same time shows that the currents carry large quantities of larvae into our waters.

The growth of the cod has been examined through measurements and age analyses, and it is found to be more rapid in the North Sea and Skagerak than anywhere else in our waters (Fig. 29). The measurements and age analyses of the Baltic cod have given further evidence as to the importance of the immigration from outwards for the renewal of the stock of cod in the Baltic (p. 60). The age at which sexual maturity is attained varies to some extent from one area to another, the bulk of the North

Sea cod becoming sexual mature at an age of c. 3—4 years, and the bulk of the Baltic cod at an age of 2—4 years. There is a considerable difference as regards the size of the individuals in our different waters when reaching this stage. The bulk of the Baltic cod are becoming sexually mature at a length of 25—30 cm., whilst the cod of the North Sea and the Skagerak generally are not attaining sexual maturity before reaching a length of c. 60—70 cm.

The food of the cod has been investigated on the basis of 1130 cod with food in their stomachs (see Tables 19 and 20). The 0-Gr. feed chiefly upon *Copepods, Mysids, Gammarids* and *Polychaets;* in a sample from the North Sea, herring larvae were found in great numbers in the stomachs. The cod between 15—30 cm feed chiefly upon *Polychaets, Gammarids, Idotea,* and smaller *Decapods* (*Crangon*), the 0-Gr. of cod and whiting too being often found in the stomachs. In the stomachs of medium cod, 30—50 cm., fish are somewhat more common (*Gobius, Ammodytes* etc.) and in the larger cod (above 50 cm.) are found chiefly fish (dabs, cod, whiting, herring, sprat, *Lumpenus* and in some cases plaice) and larger crustaceans (*Portunus, Carcinus, Eupagurus, Nephrops*). As a consequence of the greatly varying food, the cod in many different respects influence the economy of the sea, and this influence is of importance owing to the large numbers of cod in nearly all our waters.

The fluctuations in the age composition of the cod stock in the course of years have been subjected to special investigations. The fluctuations in the number of larvae have been studied through fishing experiments with the ring trawl in spring 1923—29, and the fluctuations in the quantity of older cod have been investigated through fishing with a finemeshed otter-trawl (the "tog") in 1919—29. The investigations of the number of cod larvae show that the years 1923, 1925, and 1927 were favourable for the development of cod fry, whereas 1924 and 1926 were very unfavourable, 1928 being somewhat below normal, and 1929 very nearly normal; this may be seen from Table 11 and from Fig. 42. The results of the fishing with the tog are given in Table 21. Further, on page 87 are stated the results of some age analyses carried out on marketable cod caught in 1929. Fig. 41 presents the data relating to the fluctuations in the number of larvae and of individuals of the 0-Gr., I-Gr. and II-Gr. It is interesting to see that there is a very close agreement between the fluctuations in the number of larvae in spring, the number of the 0-Gr. in the following summer, of the I-Gr. in the succeeding year, and of the II-Gr. in the year after. This makes it clearly evident that in any given year the amount of fry produced has a preponderating influence on the numbers of this year class in the succeeding years. This again means that the conditions encountered by the cod in its larval stage have a far greater influence on the numbers of the year class in question in the succeeding years than all the other influences combined which this year class encounters later. It is thus in the larval stage that the abundance of a year class is mainly determined.

For the years 1919—22 we have no observations as to the abundance of the larvae but only as to the numbers of the 0-, I- and II-Gr. but as there is a strong coincidence between the numbers of larvae and the numbers of these age groups of the same year class we can very well, from the abundance of the age groups, form an opinion as to the amount of larvae in the years 1917—22. A consideration of the curves on Fig. 41 then tells us that in the period 1917—27 good and bad survival years for the fry have alterated regularly, 1917, 1919, 1921, 1923, 1925 and 1927 have been good survival years, and 1918, 1920, 1922, 1924, and 1926 bad survival years. The years 1928 and 1929 have been to some extent normal.

Now naturally arises the question:— what are the causes of these annual fluctuations in the amount of cod fry. During the study of sea fishes it has always been a rather disputed question whether the fluctuations in the amount of spawning fish are of any importance for the number of larvae developed. On p. 93 I have put together the observations regarding the number of eggs and of larvae. These observations tend to show that the fluctuations in the amount of eggs produced do not in any

appreciable degree influence the number of larvae developed, but the observations are too scanty for us to regard the question as in any way settled.

A distinct accordance has been shown to exist between the temperature of the bottom water in March—April—May and the quantity of larvae (see Fig. 42). Also for the years before 1923, from which we have no observations of larvae, there is found both from the Kattegat and the Belt Sea (p. 95) a distinct agreement between the number of fry developed and the temperature of the bottom water: high temperatures coinciding with large numbers of fry and low temperatures with small numbers. It is evident that the fact of high temperatures being favourable for the fry is due to their producing a large amount of plankton, i. e. better food conditions for the larvae.

A really distinct agreement between the temperature of the bottom water and the quantity of fry can not be shown for other months than the spring months mentioned here. There is, however, some agreement between the temperature of the surface water in January and February and the quantity of fry in spring time, the cause of this is no doubt that in mild winters the winter minimum of the plankton does not sink so far as in more severe winters.

As to the salinity a distinct agreement has been found between the amount of larvae and the salinity of the bottom water in November—December of previous year (see Fig. 43 and p. 97). Here there is no question as to an influence on the eggs or the larvae, as the spawning in the Belt Sea only begins in January or February. The agreement may possibly be explained in the following manner: In the autumn a migration of large and mature cod takes place from outside into the Belt Sea (see p. 99), these cod again emigrate in spring. In those very years when the salinity is high in November and December very many cod ready for spawning come into the Belt Sea with the strong ingoing salt water current, particularly large quantities of eggs are then spawned, and a particularly large amount of larvae develops. This agreement thus tells us that in certain cases fluctuations in the amount of eggs spawned may result in fluctuations in the quantity of larvae developed.

The fishery statistics show that there has been a very rapid rise in the Danish cod fishery in the period after 1914 and especially in the later years of the period (p. 102). In many cases when a rise in the yield of a fishery has been recorded the cause of it has been an increased intensity of fishing. But as to the cod fishery there is strong evidence that the cause of the rise in the yield is not due to an increased fishing but to an increased cod stock. Firstly, a rise in the number of fishing implements used in the cod fishery can not be shown for the period in question, and secondly, the price of the cod has in recent years sunk more than the prices of any other of our important food fishes, so that it can not have had any stimulating effect on the intensity of the cod fishery — rather the reverse (p. 104). Not merely the fishery statistics but also the scientific fishing experiments with the trawl show that there has been an increase in the cod stock in our inner waters, far more cod being taken per fishing hour with the same implement in the years 1922—26 than in the years 1903—1907 (p. 105). These facts show that at any rate in our inner waters, from the Kattegat through the Belt Sea into the Baltic, the cod stock has increased so that it now is considerably larger than for a number of years previous to 1914.

An investigation as to the causes of this increase in the cod stock show that, firstly, we have had in the years 1915—29 more springs with high temperatures of the bottom water than in the years 1900—14, so that the conditions for the development of the larvae have been better in the years after 1915 than in the years before. Secondly the amount of food available for the growing up cod has been larger in recent years than previously, as the stock of fish (e. g. plaice) which compete with the growing up cod has greatly diminished. Thirdly, evidence is to hand showing that the conditions for the drifting in of larvae and young bottom stages of the 0-Gr. were better as a rule in the years 1915—29 than in the years 1901—14.

Dansk Resumé.

Torsken findes i Mængde i alle de danske Farvande, og saa godt som overalt spiller den en betydelig Rolle for vort Fiskeri. Torsken trænger langt ind i Østersøen, hvor den kun mangler i den allernordligste Del. I vore Have findes den saavel langs Kysterne paa Zostera- og Sandbund som paa noget dybere Vand, baade paa Stenbunden og Mudderbunden. Paa Slambunden paa mere end 300 m's Dybde er den sjælden.

En Række videnskabelige Fiskeforsøg med Travl og Aaletog giver os en Oversigt over Torskens Udbredelse. Paa Kortene, Fig. 1—4, er vist Forekomsten af Torsk paa de Lokaliteter, der er befisket fra "Thor" og "Dana" i Aarene 1903—1907 og 1922—1927 samt fra "Japetus Steenstrup" i Aarene 1927 og 1928. I Tab. 1, 2 og 3 er Resultaterne af disse Fiskeforsøg givet i tabellarisk Form. I Nordsøen og Skagerak er Torsken almindelig paa Dybder indtil ca. 100 m. Paa noget større Dybder mellem 100 og 200 m er den i Reglen temmelig faatallig, og paa Dybder mellem 200 og 400 m er der kun taget enkelte Individer. Det er kun de større og ældre Torsk, der naar ud paa de større Dybder. I Kattegat er Torsken hyppigst paa Mellemdybder mellem 20 og 60 m, sjældnere er den paa det ganske lave Vand langs Kysterne (hvor dog Aarets Yngel kan forekomme i store Mængder) og i den dybe Rende i det nordøstlige Kattegat. I Østersøen ved Bornholm tages Torsken i størst Mængde i de nedre, saltere Vandlag mellem 40 og 80 m; i de dybeste Partier, 90—100 m, er den — sandsynligvis paa Grund af den her fremherskende Iltmangel — mindre talrig.

Raceanalyser af Torsk fra forskellige Steder i vore Farvande er udført. I Nordsøen og det nordligste Kattegat er det fundne Hvirvelmiddeltal 52,10. I det sydlige Kattegat og Bælthavet varierer Middeltallet mellem 51,60 og 51,80. Analyser af Antallet af Straaler i 2den Rygfinne viser, at dette er højere i Nordsøen (18,91) end i Kattegat og Bælthavet (17,73—18,64). Ved Bornholm er Middeltallet saa lavt som 17,50. Forskellen mellem Straaletallet for Nordsøen og for Østersøen er saa stor, at vi maa være berettiget til at antage, at det her drejer sig om forskellige Racer af Torsk: en Nordsørace og en Østersørace. Ved en Betragtning af Middelstraaletallet i Forhold til Alderen (Tab. 4) ses det, at de ældre Aldersgrupper i det sydlige Kattegat, Bælthavet og Østersøen, har væsentligt højere Middeltal end de yngre. Dette viser, at de ældre Aldersgrupper er blevet opblandet med Torsk, hvis Middeltal af Straaler ligger højere end for den i Farvandene fødte Bestand, hvilket atter viser, at der til det sydlige Kattegat, Bælthavet og Østersøen finder en Indvandring Sted af Torsk fra det nordligste Kattegat, Skagerak og Nordsøen. At denne Indvandring er af betydeligt Omfang ses deraf, at Straaletallet sættes stærkt i Vejret. Denne Indvandring spiller altsaa en betydelig Rolle for Bestandens Fornyelse i de paagældende Farvande.

Torskens Gydning er undersøgt dels gennem Fiskeri med Hensen-Net efter Æggene og dels gennem Analyser af Modenhedsgraden af den voksne Fisk til forskellige Aarstider. Paa Kortene, Fig. 6—14, er angivet Antal af Torskeæg taget pr. 1 m^2 Overflade i Træk fra Bund til Overflade med Hensen-Net i Aarene 1923—1929, og i Tab. 6—7 er anført de tilsvarende gennemsnitlige Antal af Æg taget i forskellige Farvande i forskellige Maaneder. I Tab. 8 er opført Iagttagelserne over Modenhedsgraden. Sammenstilles Iagttagelserne over Modenhedsgraden og Ægmængden til forskellige Tider af Aaret, ses det, at i Kattegat er Gydningen endt med Udgangen af April. I Bælthavet er Marts Hovedgydemaaneden, og Gydningen slutter her i April eller i Begyndelsen af Maj. I den Vestlige Østersø er Gydningen endnu i Maj af ret betydeligt Omfang, og i den egentlige Østersø omkring Bornholm er Juni Maaned Hovedgydetiden, og

endnu i August finder der her en betydende Gydning Sted. En Undersøgelse af Bundvandets Temperatur (Tab. 9) paa de Steder og til de Tider, hvor Gydningen finder Sted, viser, at den stærkeste Gydning foregaar i Vand af 4°—6°. Denne Temperatur indtræder ikke i helt de samme Maaneder i vore forskellige Farvandsomraader. I Kattegat har Bundvandet i Januar—April en Temperatur af ca. 4°—6°. I Bælthavet og den Vestlige Østersø er Temperaturen i Januar og Februar kun ca. 2°—3°. Her foregaar Hovedgydningen da ogsaa noget senere i Marts og April. I Bornholmsdybet, hvor Vandet end ikke i Sommertiden naar over ca. 6°, varer Gydningen ved lige til August eller Begyndelsen af September.

I vore indre Farvande findes Torskens Æg især udenfor 20 m Kurven og her i de nedre Vandlag, medens det øvre, brakke Vandlag er fattigt paa Torskeæg. Ved Bornholm findes Æggene paa endnu dybere Vand udenfor 50 m Kurven.

Til Belysning af Torskelarvernes Udbredelse foreligger en Række Fiskeforsøg med Ringtravl og Yngeltravl for Aarene 1923—1929 (Fig. 15—19 og 21—25). I Tab. 11 er opført det gennemsnitlige Antal Larver taget pr. ½ Time i forskellige Farvande i Aarene 1923—1929. Larverne forekommer talrigst i Nordsøen, det sydvestlige Kattegat, Bælthavet og den Vestlige Østersø; mindre talrige er de i Skagerak, det nordøstlige Kattegat og den egentlige Østersø. De findes i størst Antal i de nedre Vandlag. Kun de dybeste Dele af vore Farvande danner en Undtagelse fra denne Regel: I Østersøen forekommer Larver kun i ringe Mængder nedenfor 70 m Kurven (Tab. 12). Aarsagen hertil er utvivlsomt den ringe Iltmængde (kun 1—5 ccm per Liter) i disse Dybder. I Skagerak nedenfor 100 m's Dybde er Torskelarverne ligeledes særdeles sjældne; Grunden hertil er den, at der i disse Dybder kun er meget lidt Føde for Larverne (se Fig. 20).

Betragtes Kortene, Fig. 15, 16 og 18, ses det, at Torskelarverne forekommer i særlig Mængde i de Bassiner og Render, der findes foran de Tærskeler, der syd og nord for Lille Bælt-Snævringen, ved Gedser—Darss og Amager—Skaane til en vis Grad spærrer for de indadgaaende Saltvandsstrømme. De rige Forekomster af Larver i disse Omraader kan sikkert betragtes som Opstuvningsfænomener.

Torskens Vækst er undersøgt ved Længdemaalinger og Aldersbestemmelser ved Hjælp af Ørestene. Væksten er betydeligt større i Nordsøen, Skagerak og det nordligste Kattegat end andre Steder i vore Farvande (se Fig. 29). Alderen ved Kønsmodenhedens Indtræden varierer noget fra Farvand til Farvand. I Nordsøen bliver Torsken saaledes kønsmoden først i 3—4 Aars Alderen, medens ved Bornholm en Del Torsk er modne i en Alder af 2 Aar og de fleste i en Alder af 3 Aar. Da Vaksthastigheden er saa forskellig fra Nordsøen til Østersøen, er den gennemsnitlige Længde ved Kønsmodenhedens Indtræden langt større i Nordsøen (ca. 60 cm) end i Farvandene omkring Bornholm (ca. 25—30 cm).

Undersøgelser af Føden er blevet udført paa 1130 Torsk (Tab. 19 og 20). De mindste Individer af 0-Gr. lever hovedsagelig af smaa Krebsdyr, de noget større Individer af denne Aldersgruppe tager tillige en Del Børsteorme. I en enkelt Prøve fra Nordsøen er Sildelarver fundet i stort Antal i Maverne. Torsk paa mellem 15 og 30 cm lever især af Børsteorme, Tanglopper, Tanglus, Hesterejer og andre mindre Dekapoder, smaa Torsk og Hvillinger findes ogsaa ofte i Maverne. I de noget større Torsk findes Fisk og Strandkrabber hyppigt. I Maverne af store Torsk (over 50 cm) forekommer især Fisk (Hvilling, Ising, Sild m. fl.), Krabber, Eremitkrebs, Konksnegle og Slangestjerner. I det nordvestlige Kattegat findes tillige Rødspætter hyppigt i Maverne.

Som Følge af denne stærkt varierede Føde vil Torsken paa mange forskellige Omraader kunne komme til at gribe ind i Havets Husholdning, og paa Grund af Torskens store Individmængde i saa at sige alle vore Farvande vil denne Indgriben kunne blive af Betydning.

Vekslinger i Torskebestandens Sammensætning efter Alder i Aarenes Løb er gjort til Genstand for særlige Undersøgelser, idet Mængdefluktuationerne ikke blot i Torskebestanden i sin Helhed, men ogsaa i de enkelte Stadier af Torskens Liv: 0-Gr. (Larve- og Bundstadiet), I-Gr. o. s. v. er behandlet.

Vekslingerne i Mængden af Torskelarver er undersøgt gennem Fiskeforsøg med Ringtravl og Yngeltravl i Aarene 1923—29, og Vekslinger i Mængden af ældre Stadier ved Fiskeforsøg med Aaletog i

1919—29. Larveundersøgelserne har vist, at Aarene 1923, 1925 og 1927 maa betragtes som gode Yngelaar, 1924 og 1926 som daarlige, 1928 som noget under det normale og 1929 som meget nær normalt (se Tab. 11 og Fig. 42). Resultaterne fra Fiskeriet med Aaletog er anført i Tab. 21. Fig. 41 viser Vekslingerne i Mængden af Larver og Bundstadier af 0-Gr. samt I- og II-Gr. Det er interessant at se, at der er en meget nær Overensstemmelse i Vekslingerne fra Aar til Aar i Antal af Larver om Foraaret, af 0-Gr. i den paafølgende Sommer, af I-Gr. i det følgende Aar og af II-Gr. i det næstfølgende Aar. Disse Overensstemmelser viser, at den i et bestemt Aar fremkomne Larvemængde er af afgørende Betydning for Individmængden af denne Aargang i de følgende Aar. Det vil igen sige, at *de Kaar, som møder Torsken paa Larvestadiet, er af langt større Betydning for den paagældende Aargangs Individrigdom i de følgende Aar end Summen af alle de ydre Paavirkninger, der senere hen møder Aargangen.* Det er altsaa Larvestadiet, der er det absolut kritiske Stadium i Torskens Liv. Er en Aargang af Torsk først sluppet vel over Larvestadiet, da vil den kunne gøre sig stærkt gældende i den samlede Torskebestand i Løbet af de kommende Aar. Dette vil igen sige, at vi gennem Bestemmelser af den Mængde Larver, der vokser op i et givet Aar, har et godt Middel til Bedømmelse af, hvilken Betydning denne Aargang vil faa for Fiskeriet.

Den Kendsgerning, at det er allerede paa Larvestadiet, at en Aargangs Individmængde i Hovedsagen bliver bestemt, er fra et praktisk Synspunkt af stor Interesse i Tilfælde af, at man vil paabegynde en kunstig Udklækning af Larver af Torskefisk.

Det samlede Resultat vedrørende aarlige Vekslinger i Yngelmængden af Torsk af disse Fiskeforsøg med Tog i Aarene 1919—1929 er da, at i Aarene 1917 til 1927 (11 Aar) har gode og daarlige Yngelaar skiftet regelmæssigt, saaledes at hvert andet Aar har været et godt Yngelaar og hver andet Aar et daarligt Yngelaar. Aarene 1917, 1919, 1921, 1923, 1925 og 1927 har været gode Yngelaar, i hvilke der er fremkommet megen Torskeyngel, medens Aarene 1918, 1920, 1922, 1924 og 1926 har været daarlige Aar. Udsvingene fra det normale i den Periode har været størst for Aargangene 1922, 1923 og 1924. Aargangene 1928 og 1929 har begge været temmelig nær det normale.

Spørgsmaalet er nu, hvad er Aarsagen til disse betydelige Vekslinger i Yngelmængden fra Aar til Aar. Indenfor Fiskeribiologien har det altid været et omstridt Spørgsmaal, hvorvidt Mængden af gydende Fisk spiller en betydende Rolle for Larvemængden. Paa S. 93 er sammenstillet Iagttagelser over Ægmængden og Larvemængden i en Række Aar i Perioden 1909—1929. Iagttagelserne peger nærmest i Retning af, at den Larvemængde, der fremkommer i et givet Aar, kun i ringe Grad er afhængig af den Ægmængde, der gydes, d. v. s. af Mængden af gydende Fisk; dette gælder dog kun, naar Bestanden har en vis anselig Størrelse.

En udpræget Samafvigelighed er iagttaget (Fig. 42) mellem Variationer i Bundvandets Temperatur i Maanederne Marts, April og Maj og Mængden af Torskelarver i Aarene 1923—1929, idet høje Temperaturer følges med store Larvemængder og lave Temperaturer med smaa Larvemængder. Ogsaa for Aarene 1917—1922 (hvorfra Larveundersøgelser mangler, men hvor Undersøgelserne har omfattet 0-, I- og II-Gr.) er det iagttaget, at høje Temperaturer følges med gode Yngelaar og omvendt. Der er god Grund til at antage, at Aarsagen til, at de høje Temperaturer er gunstige for Yngelen, er den, at de fremkalder større Planktonmængde, d. v. s. bedre Ernæringskaar for Larverne.

En virkelig tydelig Overensstemmelse mellem Temperaturen af Bundvandet og Yngelmængden i Foraaret er ikke fundet for andre Maaneder end de her nævnte Foraarsmaaneder. Der er imidlertid nogen Overensstemmelse mellem Overfladevandets Temperatur i Januar og Februar og Yngelmængden i Foraaret. Aarsagen hertil er aabenbart, at Planktonets Vinterminimum ikke bliver saa lavt i milde Vintre som i strenge.

Med Hensyn til Saltholdigheden, da er der fundet en tydelig Overensstemmelse mellem Mængden af Larver om Foraaret og Bundvandets Saltholdighed i November—December i det foregaaende Aar (se Fig. 43 og S. 97). Her kan der ikke være Tale om en direkte Indflydelse paa Æg eller Larver, eftersom Gydningen i Bælthavet først begynder i Januar eller Februar. Denne Overensstemmelse kan imidlertid

sikkert forklares paa følgende Maade: Om Efteraaret foregaar der en Indvandring af store og kønsmodne Torsk udefra til Bælthavet (se S. 99), disse Torsk udvandrer igen om Foraaret. Nu finder der netop en særlig stærk Indstrømning af Saltvand Sted til vore indre Farvande om Efteraaret, altsaa samtidig med at Torsken kommer, og der er da Grund til at antage, at Torskens Indvandring staar i Forbindelse med Saltvandsindstrømningen. I Aar med usædvanlig stærk Indstrømning i November—December vil der da sandsynligvis følge særlig mange gydefærdige Torsk med ind i vore indre Farvande, særlig store Mængder af Æg vil gydes, og særlig store Larvemængder klækkes. Den her fundne Overensstemmelse peger saaledes i Retning af, at Mængden af gydende Fisk i visse Tilfælde kan være af Betydning for den Larvemængde, der fremkommer.

Fiskeristatistikken viser, at der har været en meget stærk Stigning i Udbyttet af de danske Torskefiskerier i Aarene efter 1914 og da særlig i de sidste 10 Aar (Tab. 22). I de fleste Tilfælde, hvor man har iagttaget en Forøgelse af Udbyttet af et Fiskeri, har denne været Følgen af en øget Fiskeriintensitet. Der er imidlertid stærke Grunde til at antage, at det øgede Udbytte af Torskefiskeriet ikke skyldes øget Fiskeri men derimod en øget Torskebestand. For det første kan der ikke paavises nogen Forøgelse i Antallet af Redskaber benyttet ved Torskefiskeriet i den foreliggende Aarrække; for det andet er Prisen paa Torsk faldet stærkere end Prisen paa nogen anden af vore vigtigere Fødefisk, saaledes at Prisen ikke har kunnet bidrage til at øge Intensiteten af Torskefiskeriet — snarere det modsatte (S. 104). Ogsaa de videnskabelige Fiskeforsøg med Travl viser, at Torskebestanden i al Fald i vore Farvande indenfor Skagen er blevet stærkt øget i de senere Aar, idet langt flere Torsk er taget per Travltime med samme Redskab i Aarene 1922—1927 end i Aarene 1903—1907 (S. 105 og Tab. 1).

En Undersøgelse af Aarsagerne til den øgede Torskebestand viser, at vi i Aarene 1915—1929 har haft flere Foraar med høje Bundvandstemperaturer end i Aarene 1901—1914, saaledes at Betingelserne for Larvernes Udvikling har været bedre i Aarene efter 1915 end i Aarene før. Endvidere har den Fødemængde, der har været til Raadighed for den opvoksende Torsk, været større i de senere Aar end tidligere, fordi Bestanden af Rødspætte og Aal, der er Ernæringskonkurrenter til Torsken er blevet formindsket. Endelig har Betingelserne (stærk Saltvandsindstrømning) for Inddrift af Larver og unge Bundstadier af 0-Gr. været bedre i Aarene 1915—1929 end i Aarene 1901—1914.

Table I. List of Stations where Cod Larvae were caught in Ringtrawl or in Petersens' Young Fish Trawl in the Waters round Denmark in the years 1923—1929.

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1923										
2937	1/4	17 miles W. by S. of Rubjerg Knude ...	57°21′	9°17′	20	65	30	1	..	7	..
2939	—	21 miles N. of Anholt Light	57°5′	11°30′	25	90	—	1	..	15	..
2943	16/4	S. of Hveen	55°51′	12°46′	34	65	—	149	5	..	18
2944	17/4	Skjeldervigen	56°20′	12°40′	18	10	—	316	4	..	23
—	—	—	—	—	—	50	—	36	6	..	15
2945	—	8 miles NW. of Kullen	56°23′	12°15′	32	30	—	0	..	..	..
—	—	— —	—	—	—	90	—	75	7	..	21
2946	—	E. of Lysegrunden	56°18′	11°51′	27	10	—	0	..	..	..
—	—	—	—	—	—	60	—	62	7	..	23
2947	—	3 miles S. 1/2 E. of Hesselø	56°9′	11°44′	23	10	—	0	..	..	..
—	—	— —	—	—	—	60	—	12	5	..	24
2948	18/4	5 miles W. by N. of Gilleleje Flak	56°11′	12°9′	21	10	—	9	6	..	17
—	—	— —	—	—	—	55	—	130	6	..	25
2949	—	2 miles W. by N. of Gilbjerg Hoved....	56°8′	12°13′	8	at bottom	—	10	10	..	18
2950	—	3 miles ESE. of Nakkehoved Light.....	56°7′	12°26′	9	30	—	16	8	..	16
2951	—	1 mile ESE. of Sletten Havn	55°57′	12°34′	18	near bottom	—	3	7	8	11
2952	—	2 miles E. 1/2 S. of Rungsted Havn.....	55°53′	12°31′	11	—	—	30	7	..	21
2953	19/4	S. of Kallebodstrand	55°33′	12°26′	8	—	—	27	5	..	17
2954	—	9 miles E. by S. of Køge Havn	55°27′	12°28′	14	60	—	25	4	..	18
2957	—	3 miles NNE. 1/2 E. of Hellehavn Light .	55°3′	12°33′	21	10	—	0	..	..	..
—	—	— —	—	—	—	60	—	9	9	..	16
2958	20/4	6 miles E. by N. of Hestehoved.....	54°52′	12°20′	21	10	—	0	..	..	..
—	—	— —	—	—	—	60	—	2	9	10	11
2959	—	15 miles E. by N. 1/2 N. of Gedser Light.	54°40′	12°22′	17	surface	—	0	..	..	..
—	—	— —	—	—	—	near bottom	—	6	7	..	10
2960	—	1 mile E. of Gedser Rev L. V.....	54°27′	12°12′	25	20	—	14	7	..	18
—	—	— —	—	—	—	80	—	12	6	..	14
2961	—	12 miles SW. 1/2 S. of Gedser Light	54°24′	11°47′	21	surface	—	5	7	..	25
—	—	— —	—	—	—	60	—	30	7	..	18
2963	21/4	1 mile W. of Femern Belt L. V.....	54°35′	11°7′	28	surface	—	4	6	..	15
—	—	— —	—	—	—	60	—	19	..	..	..
2964	—	2.5 miles SE. by S. of Kjelsnor L.	54°42′	10°46′	23	surface	—	7	7	..	17
—	—	— —	—	—	—	60	—	21	7	..	23
2965	—	7 miles SW. by W. 1/2 W. of Bagenkop ..	54°41′	10°31′	30	20	—	3	7	8	11
—	—	— —	—	—	—	80	—	9	..	..	..
2966	—	9 miles WNW. of Bagenkop	54°47′	10°26′	26	30	—	1	..	31	..
2969	23/4	2 miles SE. of Marstal	54°50′	10°35′	8	at bottom	—	6	8	..	15
2971	—	8 miles S. 1/4 W. of Skjoldnæs Light	54°50′	10°14′	33	surface	—	0	..	..	..
—	—	— —	—	—	—	near bottom	—	16	4	6	29
2973	—	8.5 miles SW. of Vejsnæs Nakke.....	54°42′	10°17′	21	20	—	0	..	..	..
—	—	— —	—	—	—	80	—	1	..	11	..
2974	24/4	1 mile ESE. of Spodsbjerg.....	54°56′	10°53′	26	10	—	8	7	..	22
—	—	— —	—	—	—	70	—	117	..	..	..
2975	—	1 mile ESE. of Vresen	55°13′	10°56′	11	30	—	71	6	..	25
2976	—	6 miles N. 3/4 W. of Sprogø	55°26′	10°55′	26	20	—	2	15	21	26
—	—	— —	—	—	—	80	—	248	5	..	18
2977	—	1/2 mile E. of Kerteminde.....	55°27′	10°41′	12	at bottom	—	71	6	..	16
2978	25/4	7 miles N. 1/2 W. of Refsnæs	55°51′	10°49′	45	30	20	68	5	..	27
—	—	— —	—	—	—	90	—	172	4	..	22
2979	—	5 miles SE. by E. of Hjelm	56°6′	10°57′	30	10	—	0	..	..	..
—	—	— —	—	—	—	70	—	152	5	..	17

Table I (continued).

Station No.	Date	Locality	Central Position		Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm.		
			N.	E.					minimum	average	maximum
	1923										
2980	25/4	11 miles SE. 1/2 E. of Fornæs.....	56°21′	11°15′	22	10	20	7	6	..	24
—	—	— —	—	—	—	70	—	2	5	..	13
2981	—	6 miles ESE. 1/4 E. of Anholt Light.....	56°43′	11°50′	44	55	40	6	4	..	7
2982	26/4	12 miles SE. 1/2 E. of Anholt Knob L. V.	56°40′	12°11′	37	75	—	75	4	..	23
2983	—	6.5 miles NNW. of Anholt Knob L. V...	56°52′	11°46′	47	30	20	26	4	..	9
—	—	— —	—	—	—	80	—	3	6	6	6
2984	—	12 miles W. 1/2 S. of Fladen L. V.	57°7′	11°28′	60	65	40	5	4	..	10
2987	28/4	8 miles NNW. 1/4 W. of Hirsholmene....	57°36′	10°28′	6	near bottom	40	6	4	..	8
2991	29/4	9.5 miles SW. by S. of Paternoster Light	57°45′	11°20′	85	20	—	1	..	8	..
—	—	— —	—	—	—	150	—	0	..	..	..
2992	—	7 miles NNW. 1/4 W. of Måseskär Light..	58°11′	11°13′	62	30	60	3	4	..	11
—	—	— —	—	—	—	80	30	2	6	..	8
2994	30/4	11 miles NW. by W. 1/2 W. of Højen Light	57°48′	10°15′	82	20	—	1	..	18	..
—	—	— —	—	—	—	150	—	2	10	11	12
2997	—	17 miles W. by S. of Rubjerg Knude Light	57°21′	9°18′	15	50	—	154	5	..	18
2998	—	11 miles NE. by E. 1/4 E. of Hanstholm Light	57°14′	8°51′	23	10	—	3	10	13	18
—	—	— —	—	—	—	60	—	27	8	..	14
2999	1/5	10 miles E. by N. 1/4 N. of Hanstholm Light	57°11′	8°53′	15	25	—	95	6	..	16
3000	—	1.5 mile N. by E. 1/2 E. of Vigsø Bn. ...	57°07′	8°46′	7	25	—	4	7	..	11
3001	2/5	9 miles N. 1/2 W. of Lodbjerg Light.....	56°58′	8°12′	24	10	—	0	..	..	..
—	—	— —	—	—	—	60	—	18	6	..	17
3002	—	2 miles SW. by W. of Agger Bn.....	56°44′	8°11′	9	near bottom	—	1	..	8	..
3003	—	7 miles W. 1/2 N. of Bovbjerg Light.....	56°30′	7°54′	24	20	—	1	..	9	..
—	—	— —	—	—	—	70	—	50	5	..	15
3004	—	12 miles W. 1/2 N. of Lyngvig Light	56°02′	7°45′	26	30	—	8	..	..	..
—	—	— —	—	—	—	80	—	1	..	8	..
3006	5/5	6 1/2 miles SSE. of Vyl L. V.	55°16′	7°47′	22	20	—	46	5	..	25
—	—	— —	—	—	—	70	—	8	5	..	21
3007	—	23 miles SW. 1/4 W. of Vyl L. V.	55°10′	7°05′	33	30	15	110	6	..	20
—	—	— —	—	—	—	80	—	18	5	..	22
3008	6/5	41 miles SW. by W. 3/4 W. of Horns Reef L. V.	55°11′	6°20′	45	40	—	23	5	..	17
—	—	— —	—	—	—	90	—	14	4	..	19
3009	—	25 miles NW. by W. 3/4 W. of Horns Reef L. V.	55°40′	6°35′	40	30	—	24	6	..	20
—	—	— —	—	—	—	80	—	94	4	..	19
3010	—	38 miles NW. by W. 3/4 W. of Lyngvig Light	56°12′	7°00′	35	40	—	54	4	..	25
—	—	— —	—	—	—	90	—	194	5	..	20
3012	7/5	32 miles W. by N. 1/2 N. of Bovbjerg Light	56°34′	7°09′	31	40	—	40	6	..	22
—	—	— —	—	—	—	90	—	33	9	..	16
3013	—	32 miles NW. by W. 1/4 W. af Lodbjerg Light	57°00′	7°20′	39	40	—	1	..	..	..
—	—	— —	—	—	—	90	—	273	4	..	21
3014	—	41 miles NW. 1/4 W. of Hanstholm Light..	57°28′	7°30′	135	50	—	0	..	..	..
—	—	— —	—	—	—	100	—	2	6	8	10
3015	—	21 miles NNW. 1/2 W. of Hanstholm Light	57°24′	8°13′	70	40	—	2	12	13	14
—	—	— —	—	—	—	90	—	98	5	..	21
3022	9/5	26 miles NW. by W. 3/4 W. of Rubjerg Kn. L.	57°35′	8°59′	41	40	—	35	9	13	19
—	—	— —	—	—	—	90	—	94	4	..	24
3023	—	9 miles NW. by N. of Hirshals Light...	57°42′	9°45′	60	40	—	29	5	..	24
—	—	— —	—	—	—	90	—	110	6	..	23
3036	13/5	1 mile NNW. of Hals Barre Light.....	56°58′	10°25′	7	near bottom	20	170	4	..	28
3037	14/5	6 miles NW. by W. of Østre Flak L. V.	57°01′	10°44′	13	30	5	7	4	..	22
3038	—	2 miles N. 3/4 E of Læsø Rende L. V....	57°15′	10°42′	20	surface	15	146	6	..	29
—	—	— —	—	—	—	near bottom	—	229	5	..	24
3040	15/5	12 miles SE. by S. of Skagen L. V.....	57°38′	10°38′	32	10	30	3	13	17	25

Table I (continued).

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1923										
3040	15/5	12 miles SE. by S. of Skagen L. V.	57°38′	10°38′	32	75	30	2	10	11	12
3042	—	8.5 miles N. 1/2 E. of Højens Light	57°53′	10°33′	130	surface	—	0	..	..	..
—	—	— —	—	—	—	intermediate	—	11	8	..	21
—	—	— —	—	—	—	near bottom	60	4	12	..	18
3043	16/5	45 miles N. 1/4 W. of Hirshals Light	58°19′	9°37′	c. 500	50	240	8	7	..	20
—	—	— —	—	—	—	600	—	0	..	..	..
—	—	— —	—	—	—	1100	—	0	..	..	..
3044	—	30 miles NNW. 1/4 W. of Højens Light	58°08′	10°02′	300	70	30	1	..	14	..
3047	17/5	2.5 miles SE. by S. of Læsø Trindel L. V.	57°27′	11°23′	65	20	—	6	8	..	25
—	—	— —	—	—	—	85	—	34	6	..	23
3048	—	3 miles SE. by E. of Kobbergrunden	57°07′	11°28′	80	25	—	17	5	..	22
—	—	— —	—	—	—	90	—	43	4	..	17
3050	—	4 miles NW. of Anholt Light	56°47′	11°33′	15	20	—	41	4	..	22
3051	18/5	12.5 miles WNW. of Anholt	55°46′	11°09′	15	near bottom	—	77	6	..	29
3052	—	9 miles E. by N. of Udbyhøj Light	56°39′	10°35′	12	10	15	153	6	..	25
3054	19/5	3.5 miles NNW. of Lappegrund L. V.	56°07′	12°35′	30	30	—	280	5	..	26
3055	28/5	2.5 miles W. 1/4 W. of Landskrona	55°52′	12°45′	46	60	30	16	5	..	15
3056	—	8 miles E. 1/2 N. of Kullen Light	56°20′	12°40′	20	50	—	4	9	..	14
3057	29/5	13.5 miles NW. 1/2 W. of Hallands Väderø.	56°34′	12°12′	40	20	—	30	9	..	29
—	—	— —	—	—	—	85	—	18	5	..	37
3058	—	11.5 miles S. 1/2 E. of Anholt	56°32′	11°36′	31	10	—	0	..	..	..
—	—	— —	—	—	—	75	—	21	9	..	20
3059	—	5 miles SE. by E. of Hjelm	56°06′	10°57′	25	55	—	61	9	..	29
3060	30/5	6.5 miles E. 3/4 N. of Ballen	55°51′	10°49′	35	15	—	20	5	..	24
—	—	— —	—	—	—	—	60	146	8	..	21
3061	—	1 mile SE. by E. 1/2 E. of Ljushage Light	55°46′	10°40′	23	45	30	29	8	..	14
3062	—	2.5 miles WNW. of Vestborg Light	55°47′	10°29′	31	45	—	96	7	..	26
3063	—	4 miles NE. by E. 1/2 E. of Æbelø Light	55°42′	10°16′	21	35	—	195	6	..	29
3064	31/5	1.5 miles ESE. of Romsø Light	55°31′	10°51′	31	40	—	34	7	..	24
3065	—	E. of Vresen	55°15′	10°57′	26	40	—	419	8	..	32
3066	—	1.5 miles E. of Hov Light	55°09′	11°00′	26	50	—	585	5	..	35
3067	—	4 miles W. of Vejrø Light	55°02′	11°16′	14	20	—	8	10	..	20
3068	1/6	7 miles NE. by N. of Kjelsnor Light	54°50′	10°51′	24	40	—	130	8	..	31
3069	—	10 miles S. by W. 1/4 W. of KjelsnorLight	54°34′	10°42′	23	40	—	273	5	..	30
3070	—	5 miles NNE. of Bülk Light	54°32′	10°15′	14	25	—	715	6	..	51
3071	—	4 miles SE. by E. 1/2 E. of Sliminde Light	54°39′	10°08′	21	40	—	629	5	..	43
3072	2/6	2.5 miles ENE. of Taksensand Light	55°02′	10°01′	36	10	—	10	19	..	41
—	—	— —	—	—	—	75	—	606	5	..	35
3073	—	2 miles S. 1/2 E. of Aarø Light	55°13′	9°45′	23	35	—	877	5	..	34
3074	—	3 miles W. by N. 1/2 N. of Nordborg Light	55°05′	9°38′	28	45	20	423	5	..	21
3075	4/6	2.5 miles S. 1/2 E. of Sønderborg	54°52′	9°48′	25	40	30	1036	5	..	37
3076	—	5 miles S. 3/4 E. of Gl. Pøl Light	54°48′	10°07′	26	40	—	1780	5	..	49
3077	—	5 miles SSW. 1/4 W. of Marstal	54°47′	10°29′	26	40	15	268	5	..	40
3078	—	8.5 miles SE. 3/4 S. of Kjelsnor Light	54°38′	10°54′	22	40	—	237	5	..	31
3079	5/6	6 miles SW. of Hyllekrog Light	54°31′	11°24′	27	40	20	367	5	..	41
3080	—	15 miles S. by E. 1/2 E. of Hyllekrog Light	54°22′	11°41′	25	40	—	320	5	..	36
3081	—	2 miles SSW. 1/2 W. of Gedser L. V.	54°25′	12°10′	26	40	—	43	5	..	35
3082	—	11.5 miles E. 3/4 N. of Gedser Light	54°37′	12°17′	18	40	30	65	5	..	28
3084	6/6	6.5 miles SE. by E. of Hestehoved Light	54°47′	12°20′	23	40	—	33	5	..	25
3088	7/6	10 miles S. by W. of Møen Light	54°47′	12°31′	19	40	—	121	9	..	38
3089	—	3 miles SW. by W. 1/2 W. of Møen Light	54°55′	12°28′	22	40	—	19	10	..	22
3092	8/6	9 miles E. by N. 1/2 N. of Hellehavn Nakke L.	55°04′	12°46′	28	55	—	7	5	..	14
3093	—	9 miles SSE. 3/4 E. of Stevns' Light	55°11′	12°38′	28	55	—	1	..	12	..

Table I (continued).

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1923										
3097	9/6	19 miles E.3/4 S. of Møen Light	54°56′	13°06′	40	15	30	0	..	..	..
—	—	— —	—	—	—	80	—	3	15	..	30
3098	—	12 miles N.1/4 E. of Arkona Light	54°53′	13°25′	45	20	—	0	..	..	..
—	—	— —	—	—	..	85	—	1	..	15	..
3101	10/6	14 miles SW.3/4 W. of Adler Grund L. V.	54°39′	14°10′	30	50	—	1	..	6	..
3102	—	7 miles SE.3/4 E. of Adler Grund L. V.	54°46′	14°31′	20	30	—	2	7	9	10
3103	13/6	11 miles N. by E. of Hammer Odde L.	55°28′	14°49′	76	65	—	1	..	6	..
—	—	— —	—	—	—	130	—	25	6	..	30
3104	—	7.5 miles NW. of Hammer Odde Light	55°22′	14°38′	40	25	—	0	..	..	..
—	—	— —	—	—	—	90	—	6	7	..	32
3106	—	11 miles N. by W.3/4 W. of Christiansø L.	55°29′	15°02′	53	65	—	0	..	..	..
—	—	— —	—	—	—	130	—	14	7	..	17
3107	14/6	10 miles NNE.1/4 E. of Christiansø Light	55°29′	15°17′	78	85	—	0	..	..	..
—	—	— —	—	—	—	150	—	55	6	..	9
3109	15/6	6 miles N.1/2 W. of Sandkaas Odde	55°14′	15°07′	68	45	—	0	..	..	..
—	—	— —	—	—	—	110	—	20	5	..	9
3110	—	9 miles E. by S.1/4 S. of Sandkaas Odde	55°07′	15°24′	69	55	—	0	..	..	..
—	—	— —	—	—	—	120	—	24	7	..	15
3112	—	1.5 miles S. by E.1/2 E. of Sandkaas Odde	55°07′	15°11′	41	70	—	1	..	9	..
3114	16/6	9 miles SE. of Due Odde	54°54′	15°16′	72	55	—	0	..	..	..
—	—	— —	—	—	—	120	—	17	8	..	13
3115	18/6	7.5 miles W.3/4 W. of Hammeren	55°16′	14°33′	51	25	—	0	..	..	..
—	—	— —	—	—	—	90	—	1	..	7	..
3117	18/6	21 miles NNE.1/4 E. of Hammer Odde Light	55°28′	15°17′	74	75	—	2	6	6	6
—	—	— —	—	—	—	140	—	1	..	12	..
3119	19/6	33 miles E.3/4 S. of Sandkaas Odde	55°08′	16°08′	85	75	—	1	..	..	..
—	—	— —	—	—	—	140	—	0	..	..	..
3120	—	22 miles E. of Sandkaas Odde	55°11′	15°47′	88	85	—	0	..	..	..
—	—	— —	—	—	—	150	—	2	11	11	11
3122	20/6	7.5 miles SW. of Due Odde	54°54′	14°57′	47	80	15	1	..	9	..
—	—	— —	—	—	—	100	—	4	9	..	10
3123	—	7.5 miles WSW. of Due Odde	54°57′	14°53′	38	80	—	3	7	..	9
3125	21/6	13 miles W.1/4 N. of Rønne	55°05′	14°19′	46	25	30	0	..	..	..
—	—	— —	—	—	—	90	—	1	..	23	..
3126	—	24 miles W.1/2 S. of Rønne	55°01′	14°01′	49	35	—	1	..	7	..
—	—	— —	—	—	—	100	—	1	..	37	..
3127	—	16 miles NE. of Arkona Light	54°53′	13°43′	50	35	—	1	..	7	..
—	—	— —	—	—	—	100	—	0	..	..	..
3128	—	4 miles E. by N.1/2 N. of Arkona Light	54°42′	13°33′	37	near bottom	15	5	7	..	24
3132	22/6	14 miles SW. by S.1/4 S. of Smygehuk Light	55°08′	13°13′	38	10	30	3	15	18	24
—	—	— —	—	—	—	75	—	0	..	..	..
3139	23/6	11.5 miles S. by E.1/4 E. of Møen Light	54°46′	12°40′	19	near bottom	20	4	16	..	20
3145	24/6	2.5 miles W.1/4 S. of Landskrona	55°52′	12°45′	45	50	30	2	16	18	20
—	—	— —	—	—	—	60	10	28	5	..	24
	1924										
3159	2/4	4 miles ESE. of Hjelm	56°07′	10°54′	18	near bottom	30	12	4	4.6	6
3160	—	7 miles NE. of Ballen	55°52′	10°49′	25	60	—	2	5	5	5
3161	—	3 miles E. of Romsø	55°31′	10°53′	37	65	—	2	4	5	6
	1925										
3317	1/4	49 miles W. by S. of Blaavandshuk	55°10′	6°45′	28	55	30	228	4	..	8
3318	—	28 miles W. by S. of Blaavandshuk	55°17′	7°23′	25	55	20	30	5	..	12

Table I (continued).

Station No.	Date	Locality	Central Position		Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm.		
			N.	E.					minimum	average	maximum
	1925										
3330	5/4	22 miles NW.1/2 W. of Thyborøn	56°55′	7°36′	28	40	30	61	4	..	14
3331	—	6 miles ENE. of Hanstholm	57°10′	8°45′	15	30	60	38	5	..	14
3332	—	Vigsø Bay	57°08′	8°49′	8	near bottom	30	2	7	7	7
3333	8/4	14 miles N. by E. of Bulbjerg	57°23′	9°00′	19	40	—	12	5	..	9
3334	—	23 miles N. by E. of Bulbjerg	57°32′	9°06′	21	50	—	26	4	..	14
3335	—	32 miles WNW. of Hirshals Light	57°45′	9°02′	130	20	—	4	4	..	9
—	—	— —	—	—	—	200	—	3	4	8	11
3338	7/4	15 miles NNW.1/2 W. of Hirshals Light.	57°44′	9°37′	30	50	—	17	4	..	14
3339	—	Tannis Bay	57°42′	10°12′	17	35	—	23	4	..	14
3340	—	Tannis Bay	57°37′	10°11′	6	near bottom	—	114	5	..	14
3341	—	11 miles E. by S. of Skagen Light	57°38′	10°52′	19	20	—	15	5	..	14
3342	8/4	2 miles E. of Læsø Trindel L. V.	57°28′	11°24′	22	40	—	6	5	..	14
3343	—	E. of Kobbergrunden	57°09′	11°25′	70	20	—	46	4	..	24
—	—	—	—	—	—	50	120	325	4	..	24
3344	—	22 miles N. by E. of Anholt Knob L. V.	57°07′	11°43′	25	40	30	105	4	..	19
3345	—	13 miles N. by E. of Anholt Knob L. V.	56°58′	11°45′	62	70	—	33	4	..	14
3347	—	3 miles E. of Anholt Knob L. V.	56°46′	11°55′	45	70	—	12	5	..	15
3348	—	Store Middelgrund	56°33′	12°05′	10	10	—	13	5	..	14
3349	—	4 miles E. of Store Middelgrund	56°34′	12°13′	48	70	60	153	5	..	19
3350	14/4	2.5 miles W. of Landskrona	55°52′	12°45′	35	10	15	39	5	..	19
—	—	—	—	—	—	50	30	824	4	..	20
3351	—	Off Hornbæk	56°07′	12°32′	27	10	—	3	5	14	23
—	—	—	—	—	—	50	—	112	4	..	24
3352	—	8.5 miles E.3/4 S. of Lysegrund	56°18′	12°03′	32	10	—	48	4	..	24
—	—	— —	—	—	—	50	—	136	4	..	29
3353	—	12 miles S. of Anholt	56°31′	11°35′	31	10	—	11	5	..	24
—	—	— —	—	—	—	50	—	15	5	..	24
3354	—	8 miles SW. of Anholt	56°37′	11°22′	18	10	—	83	4	..	24
—	—	— —	—	—	—	30	—	73	4	..	24
3355	15/4	1 mile N. by E. of Læsø Rende L. V.	57°14′	10°42′	20	10	—	27	4	..	19
—	—	— —	—	—	—	40	—	43	4	..	19
3356	—	6 miles NW.1/2 W. of Østre Flak L. V.	57°02′	10°44′	13	25	—	3	5	..	9
3357	15/4	12 miles SE.1/4 S. of Hals Barre Light	56°50′	10°42′	12	25	—	31	4	..	14
3358	16/4	8.5 miles SE. by E.1/2 E. of Udbyhøj L.	56°33′	10°34′	6	10	—	348	5	..	24
3361	—	12 miles SE. by E.1/4 E. of Fornæs Light	56°22′	11°17′	36	10	—	1	..	6	..
—	—	— —	—	—	—	50	—	55	4	..	24
3362	—	3 miles SW. by S. of Schultz' Grund L. V.	56°06′	11°09′	34	20	—	9	5	..	20
—	—	— —	—	—	—	60	—	80	5	..	24
3363	—	4 miles SE. by E. of Hjelm	56°06′	10°35′	31	20	—	5	5	..	14
—	—	— —	—	—	—	60	—	15	5	..	20
3364	—	2 miles W. of Hatter Barn	55°22′	10°49′	40	20	—	2	4	6	7
—	—	— —	—	—	—	60	—	17	5	..	24
3365	—	2 miles SE. by E.1/2 E. of Romsø	55°30′	10°52′	30	10	—	106	5	..	30
—	—	— —	—	—	—	50	—	402	5	..	25
3366	17/4	1.5 miles ESE.1/2 E. of Kerteminde	55°27′	10°43′	13	25	—	18	5	..	24
3367	—	1.5 miles E. of Vresen	55°13′	10°56′	13	25	—	28	5	..	26
3368	—	3 miles NNW. of Omø Light	55°12′	11°06′	32	10	—	10	10	..	30
—	—	— —	—	—	—	40	—	26	5	..	24
3369	—	1.5 miles SE. of Spodsbjerg Light	54°55′	10°52′	29	10	—	20	5	..	19
—	—	— —	—	—	—	40	—	36	5	..	19
3370	—	9.5 miles W. by S. of Kjelsnor Light	54°41′	10°28′	30	10	—	19	5	..	19
—	—	— —	—	—	—	40	—	40	5	..	24
3371	—	3 miles W. by N. of Femern Belt L. V.	54°36′	11°04′	27	20	—	15	5	..	24

Table I (continued).

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1925										
3371	17/4	3 miles W. by N. of Femern Belt L. V.	54°36′	11°04′	27	50	30	28	5	..	24
3372	—	3 miles SE.1/2 S. of Staberhuk Light....	54°22′	11°23′	23	10	—	13	5	..	19
—	—	— —	—	—	—	40	—	74	5	..	24
3373	18/4	13 miles ESE.1/2 E. of Staberhuk Light .	54°22′	11°41′	25	20	—	0	..	..	..
—	—	— —	—	—	—	50	—	28	5	..	24
3374	—	2 miles SSW.1/2 W. of Gedser Rev L. V.	54°25′	12°10′	21	10	—	2	7	9	11
—	—	— —	—	—	—	40	—	1	..	7	..
3375	—	8 miles NE. by N. of Gedser Rev L. V..	54°35′	12°17′	25	20	—	1	..	12	..
—	—	— —	—	—	—	50	—	28	5	..	24
3376	—	6 miles SE. by E. of Hestehoved Light .	54°47′	12°20′	23	20	—	0	..	..	..
—	—	— —	—	—	—	50	—	1	..	7	..
3377	—	3 miles S. by W. of Møen Light	54°54′	12°33′	27	20	—	0	..	..	..
—	—	— —	—	—	—	50	—	2	7	8	9
3378	—	17 miles NNW.1/2 W. of Arkona Light..	54°55′	12°10′	44	30	—	25	5	..	29
—	—	— —	—	—	—	90	—	11	5	..	24
3379	19/4	11 miles SE. by S. of Stevns' Light	55°09′	12°40′	30	30	—	0	..	..	..
—	—	— —	—	—	—	60	—	1	..	12	..
3380	20/4	4 miles SE. by S. of Lysegrunden	56°15′	11°53′	25	10	360	268	5	..	29
—	—	— —	—	—	—	40	—	159	5	..	25
3381	21/4	6 miles SSE. of Kronborg	55°57′	12°42′	27	10	30	19	5	..	34
—	—	— —	—	—	—	40	—	115	5	..	24
3383	22/4	2 miles ESE.1/2 E. of Køge	55°27′	12°16′	7	near bottom	—	6	5	..	24
3384	—	5 miles NE. of Stevns' Light	55°21′	12°33′	21	near bottom	—	22	5	..	14
	1926										
3525	1/4	8 miles NW. of Bulbjerg	57°14	8°52′	22	40	30	62	4	..	9
3526	—	10 miles SE. of Kobbergrunden	57°08′	11°28′	70	75	—	4	6	8	9
3527	2/4	11 miles E. by S. of Anholt Knob L. V..	56°40′	12°10′	40	40	—	4	4	5	9
3530	26/4	3 miles N. by W.1/2 W. of Kulorne L. ..	55°48′	12°52′	15	50	—	6	6	..	9
3531	27/4	2.5 miles W.3/4 S. of Landskrona	55°52′	12°45′	15	20	—	7	5	..	9
—	—	— —	—	—	—	50	—	74	4	..	9
3532	28/4	4.5 miles NW.3/4 N. of Lappegrund L. V..	56°07′	12°32′	27	20	15	1	..	9	..
3534	—	6.5 miles NW. by W. of Kullen	56°21′	12°16′	32	20	—	3	4	..	13
—	—	— —	—	—	..	70	20	1	..	13	..
3536	—	7.5 miles E.1/2 N. of Kullen.....	56°20′	12°40′	17	30	30	17	5	..	14
3537	29/4	9.5 miles N. of Kullen.....	56°28′	12°26′	30	60	—	0	..	..	..
—	—	— —	—	—	—	100	—	2	10	11	12
3538	—	13.5 miles SE. of Anholt Light.....	56°38′	12°11′	43	20	—	0	..	..	..
—	—	— —	—	—	—	100	—	4	5	8	14
3540	29/4	5 miles SW. by S. of Anholt Knob L. V.	56°42′	11°48′	43	20	—	1	..	5	..
—	—	— —	—	—	—	100	—	14	5	..	16
3542	—	7 miles N. by W. of Anholt Knob L. V.	56°53′	11°47′	31	20	—	0	..	..	..
—	—	— —	—	—	—	100	—	2	12	13	14
3543	—	3.5 miles N. by E. of Kobbergrunden..	57°11′	11°23′	86	20	—	3	6	9	11
—	—	— —	—	—	—	100	—	4	9	..	14
3544	30/4	8 miles S.1/2 E. of Læsø Trindel L. V...	57°20′	11°23′	60	20	—	6	5	..	14
—	—	— —	—	—	—	100	—	11	5	..	14
3545	—	3 miles SE. by S. of Læsø Trindel L. V..	57°26′	11°23′	55	20	—	0	..	..	..
—	—	— —	—	—	—	100	—	18	5	..	14
3550	1/5	8.5 miles SSE.1/2 E. of Skagen L. V.	57°40′	10°53′	28	10	—	7	5	..	21
—	..	.. ..	—	—	—	60	—	8	5	..	19
3551	—	6 miles NW. by W.1/2 W. of Vinga Light	57°40′	11°25′	59	10	—	11	10	..	19
—	..	.. ..	—	—	—	120	—	17	5	..	19

Table I (continued).

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1926										
3552	2/5	17 miles N. by E.3/4 E. of Hirshals Light	57°52′	10°02′	58	20	30	2	9	9	9
—	—	— —	—	—	—	120	—	6	5	..	14
3553	—	11 miles N. of Hirshals Light	57°46′	9°52′	44	10	—	1	..	13	..
—	—	— —	—	—	—	100	—	5	5	..	14
3555	—	11 miles NW. by W. of Hirshals Light..	57°39′	9°39′	50	30	—	1	..	12	..
—	—	— —	—	—	—	70	—	0	..	..	..
3561	3/5	5 miles E.1/2 N. of Hanstholm	57°08′	8°45′	9	15	—	3	12	17	24
3562	—	10 miles NE. by E. of Hanstholm	57°14′	8°50′	22	10	—	4	9	23	27
—	—	— —	—	—	—	50	—	1	..	12	..
3563	—	18 miles NE. by E. of Hanstholm	57°20′	9°00′	19	10	—	19	10	..	19
—	—	— —	—	—	—	50	—	0	..	..	..
3564	—	10 miles ENE. of Hirshals	57°40′	10°13′	26	10	—	0	..	..	..
—	—	— —	—	—	—	50	—	1	..	14	..
3565	4/5	11 miles SW. by W.3/4 W. of Højen Light	57°38′	10°16′	9	45	—	1	..	15	..
3566	—	1.5 miles NNW.3/4 W. of Tversted Bn. ..	57°37′	10°10′	8	45	—	3	13	15	15
3568	—	5 miles NV.1/2 N. of Skagen L. V.	57°50′	10°37′	115	20	—	3	11	12	13
—	—	— —	—	—	—	220	—	0	..	..	..
3569	5/5	5 miles NW. by W. of Nordre Rønner ..	57°24′	10°47′	43	20	—	0	..	..	..
—	—	— —	—	—	..	80	—	1	..	12	..
3570	—	Læsø Rende	57°14′	10°42′	20	20	—	16	5	..	24
—	—	—	—	—	—	50	—	23	5	..	19
3573	6/5	9 miles E. by N. of Udbyhøj	56°39′	10°34′	10	10	—	4	5	..	19
3575	—	11.5 miles SE. by E.1/2 E. of Fornæs ...	56°22′	11°17′	21	20	—	5	5	..	14
—	—	— —	—	—	—	70	—	26	5	..	19
3576	—	3 miles SW. by S. of Schultz' Grund ...	56°06′	11°09′	37	20	—	5	6	8	12
—	—	— —	—	—	—	80	—	21	5	..	14
3577	—	3.5 miles NW. by N. of Sejrø Light	55°58′	11°01′	33	20	—	3	6	8	10
3578	—	2.5 miles S. by W.1/2 W. of Hatter Barn.	55°52′	10°49′	39	20	—	0	..	..	..
—	—	— —	—	—	—	60	—	4	5	..	14
3579	7/5	6.5 miles SW.1/2 W. of Vestborg Light ..	55°42′	10°26′	24	20	—	2	8	9	9
—	—	— —	—	—	—	50	—	7	7	10	25
3581	—	4.5 miles SSE.1/2 E. of Romsø	55°27′	10°53′	26	20	—	3	5	6	7
—	—	— —	—	—	—	60	—	23	5	..	14
3582	—	1.3 miles E. of Vresen	55°13′	10°56′	13	10	—	16	5	..	9
—	—	— —	—	—	—	25	—	9	5	..	14
3583	—	3 miles NW. by W. of Omø Light	55°11′	11°04′	33	20	—	4	4	7	10
—	—	— —	—	—	—	60	—	2	6	7	7
3584	—	4 miles S. by W.3/4 W. of Tranekær Light.	54°55′	10°52′	24	20	—	1	..	10	..
—	—	— —	—	—	—	60	—	3	5	..	9
3585	8/5	1 1/2 miles E.1/2 S. of Kjelsnor Light	54°44′	10°47′	23	20	—	5	5	..	9
—	—	— —	—	—	—	60	—	17	5	..	14
3586	—	6.5 miles WNW.1/2 W. of Bagenkop	54°46′	10°29′	22	20	—	4	5	..	9
—	—	— —	—	—	—	60	—	10	5	..	18
3587	—	4 miles W. of Vejsnæs Nakke	54°49′	10°19′	27	20	—	0	..	..	..
—	—	— —	—	—	—	60	—	3	7	8	10
3588	—	3.5 miles E. of Gl. Pøl Light	54°53′	10°10′	33	20	—	1	..	5	..
—	—	— —	—	—	—	60	—	0	..	...	..
3596	11/5	3 miles W.3/4 N. of Femern Belt L. V. ..	54°36′	11°04′	27	20	—	9	5	..	9
—	—	— —	—	—	—	70	—	7	5	..	9
3597	—	4.5 miles SSE.3/4 E. of Staberhuk	54°21′	11°23′	21	20	—	7	5	..	9
—	—	— —	—	—	—	60	—	18	5	..	9
3599	—	10.5 miles NNE.1/2 E. of Buk Light	54°18′	11°49′	24	20	—	3	5	..	6
—	—	— —	—	—	—	60	—	6	5	..	12

Table 1 (continued).

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1926										
3600	11/5	2 miles SSW. of Gedser Rev L. V.	54°25′	12°10′	27	20	30	15	5	..	10
—	—	— —	—	—	—	60	—	13	5	..	10
3601	—	7 miles NE. of Gedser Rev L. V.....	54°33′	12°18′	24	20	—	0	..	..	..
—	—	— —	—	—	—	60	—	4	5	..	9
3602	12/5	6 miles SE. by E. of Hestehoved L.....	54°47′	12°20′	22	20	—	20	5	..	9
—	—	— —	—	—	—	60	—	43	5	..	9
3603	—	3 miles S. by W. of Møen Light	54°54′	12°33′	32	20	—	28	5	..	9
—	—	— —	—	—	—	60	—	34	5	..	10
3604	—	8 miles E.1/4 S. of Møen Light	54°56′	12°47′	30	20	—	0	..	..	..
—	—	— —	—	—	—	60	—	1	..	6	..
3605	—	4 miles NNW. of Hellehavn Light.....	55°04′	12°28′	14	30	—	2	9	10	11
3606	—	3 miles SE.1/2 E. of Stevns Light.....	55°16′	12°32′	22	20	—	0	..	..	..
—	—	— —	—	—	—	60	—	1	..	7	..
3607	—	8.5 miles SW.1/4 W. of Drogden L. V....	55°27′	12°33′	16	20	—	3	11	..	12
—	—	— —	—	—	—	50	—	12	5	..	19
	1927										
2	1/3	NE. of Vresen	55°16′	10°57′	25	10	30	1	..	8	..
—	—	—	—	—	—	50	—	8	7	9	12
3	2/3	5 1/2 miles SSE. of Romsø.....	55°25′	10°54′	24	10	—	1	..	7	..
—	—	— —	—	—	—	50	—	8	4	6	7
4	—	4.5 miles E. by S. of Lillegrunden.....	55°39′	10°46′	33	10	—	0	..	..	..
—	—	— —	—	—	—	70	20	25	4	7	10
5	—	4 miles NNW. of Refsnæs	55°48′	10°50′	43	10	30	2	4	4	4
—	—	— —	—	—	—	90	—	42	4	7	11
7	4/3	3 miles WNW. of Sjællands Rev	56°03′	11°8′	38	10	—	10	4	6	7
—	—	— —	—	—	—	90	—	46	4	..	9
8	—	4 miles NW. by N. of Sejrø	55°58′	11°1′	44	10	—	11	4	..	8
—	—	— —	—	—	—	90	—	33	3	6	8
9	5/3	2.5 miles WNW. of Vestborg.....	55°47′	10°29′	35	10	30	0	..	..	..
—	—	— —	—	—	—	80	20	30	4	7	12
10	—	1.5 miles NNE. of Fyens Hoved	55°39′	10°36′	15	10	30	4	6	7	7
11	—	1 mile WNW. of Romsø.....	55°31′	10°46′	9	10	—	12	4	5	7
12	8/3	1 mile E. of Hov Light	55°9′	10°59′	38	10	—	3	6	6	7
—	—	— —	—	—	—	70	—	5	6	9	11
13	—	2.5 miles S. by E. of Tranekær L.	54°57′	10°54′	30	10	20	4	5	8	10
—	—	— —	—	—	—	70	30	7	4	7	22
14	—	1.5 miles W. by S. of Dines Odde.....	54°44	10°38′	17	45	—	2	5	9	13
18	9/3	2.5 miles S. of Glænø	55°8′	11°27′	13	25	—	2	6	7	7
20	10/3	6 miles ESE. of Omø	55°8′	11°21′	11	at bottom	—	1	..	13	..
21	—	4.5 miles SE. by S. of Omø	55°5′	11°15′	13	at bottom	—	4	9	10	11
23	—	2 miles SE. of Omø.....	55°8′	11°12′	11	at bottom	—	2	10	16	22
24	—	Omø Sund.....	55°11′	11°11′	38	80	—	4	5	8	12
26	4/4	1 mile ENE. of Knudshoved	55°19′	10°53′	23	10	—	20	5	..	22
—	—	— —	—	—	—	50	—	119	6	..	22
27	—	5 miles E. by S. of Risinge Hoved	55°25′	10°54′	24	10	—	24	5	..	9
—	—	— —	—	—	—	50	—	246	6	..	18
28	5/4	4.5 miles E. by S. of Lillegrund	55°39′	10°46′	33	10	—	8	5	..	10
—	—	— —	—	—	—	70	—	333	5	..	19
29	—	4 miles NW. by N. of Sejrø	55°58′	10°1′	44	10	—	6	4	..	19
—	—	— —	—	—	—	90	—	242	5	..	16
30	—	4 miles NNW. of Refsnæs	55°48′	10°50′	43	10	—	14	4	..	11
—	—	— —	—	—	—	90	—	210	5	..	16

Table I (continued).

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1927										
31	5/4	2.5 miles WNW. of Vestborg Light	55°47′	10°29′	35	10	30	10	6	..	18
—	—	— —	—	—	—	70	—	96	5	..	23
32	7/4	7.5 miles SW. by W. of Vestborg Light.	55°42′	10°22′	26	10	—	44	6	..	22
—	—	— —	—	—	—	50	—	189	5	..	23
33	—	2.5 miles NE. of Æbelø	55°41′	10°13′	22	10	—	36	5	..	14
—	—	— —	—	—	—	45	—	79	4	..	21
34	—	3.5 miles WNW. of Æbelø	55°40′	10°4′	17	10	—	5	7	14	19
—	—	— —	—	—	—	35	—	15	6	..	16
36	8/4	E. of Stenderup Hage	55°25′	9°43′	33	10	—	8	6	..	11
—	—	— —	—	—	—	70	—	20	5	..	14
39	9/4	4 miles W. of Lyø	55°2′	10°1′	34	10	—	1	..	18	..
—	—	— —	—	—	—	70	—	6	4	..	10
40	—	3 miles SW. of Skjoldnæs Light	54°56′	10°10′	34	10	—	4	4	5	5
—	—	— —	—	—	—	75	—	6	4	—	20
41	—	W. of Vodrup Flak	54°51′	10°13′	34	10	—	4	4	..	9
—	—	— —	—	—	—	75	—	11	6	..	17
42	10/4	2 miles W. of Gulstav	54°53′	10°38′	21	10	—	43	4	..	26
—	—	— —	—	—	—	45	—	108	5	..	20
43	—	2 miles ENE. of Kjelsnor Light	54°45′	10°47′	29	10	—	9	5	..	15
—	—	— —	—	—	—	65	—	330	5	..	23
44	—	1/2 mile E. by S. of Snødeøre	55°5′	10°59′	21	10	15	3	5	7	11
—	—	— —	—	—	—	50	—	155	5	..	21
59	19/4	3.5 miles N. of Hvide Tange Kost	56°42′	10°38′	14	15	30	4	4	8	12
60	—	4.5 miles S. by E. of Hals Barre	56°53′	10°29′	8	15	—	13	5	..	15
112	4/5	2.5 miles E. by S. of Hov, Jutland	57°4′	10°27′	8	10	—	9	7	..	22
115	—	12 miles E. by N. of Hals	57°1′	10°43′	11	15	—	28	6	..	30
119	5/5	7 miles SW. of Østre Flak	56°54′	10°47′	13	15	—	11	6	..	21
135	19/5	5.5 miles N. by W. of Refsnæs	55°50′	10°49′	34	10	—	17	7	..	17
—	—	— —	—	—	—	75	—	15	5	..	11
157	27/5	4 miles NW. of Anholt Light	56°46′	11°33′	13	10	—	4	9	18	25
158	28/5	3 miles SW. of Anholt Knob L. V.	56°44′	11°51′	54	10	—	3	5	13	19
—	—	— —	—	—	—	150	—	1	..	11	..
166	30/5	2 miles SE. of Romsø Light	55°30′	10°52′	31	10	—	8	6	..	18
—	—	— —	—	—	—	70	—	18	7	..	12
178	11/6	1/2 mile SE. by S. of Vengeance Grund	55°12′	11°6′	38	10	—	3	20	23	25
—	—	— —	—	—	—	80	—	1	..	14	..
631	2/9	3 miles SE. of Svaneke	55°5′	15°15′	70	160	—	61	4	..	9
634	3/9	4 miles E. by S. of Nexø	55°03′	15°16′	76	10	—	3	12	15	19
—	—	— —	—	—	—	180	—	6	6	..	10
	1928										
884	18/5	3/4 miles SSE. of Slipshavn	55°16′	10°51′	14	20	—	3	6	9	15
885	—	6 miles N. by W. of Sprogø	55°25′	10°54′	23	45	—	3	7	12	18
886	—	6 miles N. by E. of Romsø	55°38′	10°49′	36	10	—	88	5	..	24
—	—	— —	—	—	—	75	—	55	4	..	29
894	19/5	2 miles S. of Endelave	55°43′	10°20′	23	50	—	4	9	15	18
896	20/5	2.5 miles WNW. of Vestborg L.	55°47′	10°29′	30	60	—	21	7	15	26
899	—	5.5 miles N. by W. of Refsnæs	55°50′	10°50′	40	10	—	8	5	..	17
—	—	— —	—	—	—	80	—	13	5	..	24
906	21/5	3 miles SE. by S. of Aarhus	56°7′	10°17′	14	30	—	31	9	16	23
909	9/6	1.5 miles S. by W. of Halskov L. V.	55°19′	11°2′	45	100	15	12	7	11	15
911	10/6	3 miles S. of Slipshavn	55°14′	10°51′	21	50—25	20	47	6	12	25
912	—	1/3 mile W. of Vresen	55°13′	10°52′	12	10	—	6	7	13	17

Table I (continued).

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1928										
913	10/6	1.7 miles E. by S. of Lundeborg	55°8′	10°50′	16	40—20	20	11	10	13	19
917	11/6	2 miles WNW. of Skjoldnæs	54°59′	10°9′	37	90—60—30	30	2	12	12	12
918	—	1 mile N. of Taksensand	52°2′	9°58′	40	90—60—30		5	16	21	36
920	12/6	1 mile N. of Varnæs Hoved	55°4′	9°35′	34	80—40—20	--	4	5	6	7
924	—	1.8 miles NNW. of Nordborg Light	55°6′	9°40′	29	80—50—25		5	5	18	33
930	13/6	1.5 miles E. of Mommark	54°56′	10°5′	34	80—40—20	—	6	14	17	21
933	14/6	5 miles ESE. of Pøls Huk Light	54°52′	10°13′	29	80—60—20		10	10	17	23
934	—	2 miles S. by W. of Vejsnæs Nakke	54°47′	10°26′	29	80—20	20	9	13	17	22
937	18/6	2 miles SSE. of Nebbe Skov	54°52′	10°50′	47	120—70—20	30	52	6	30	31
938	—	5 miles E. by N. of Tranekær Light	55°1′	11°2′	30	75—60—20	--	46	8	17	38
939	—	1 mile E. of Hov Light	55°9′	10°59′	34	90—60— 20		23	8	17	23
943	21/6	1.5 miles ESE. of Romsø	55°31′	10°49′	34	60	—	8	9	14	22
944	—	5.5 miles N. by W. of Refsnæs	55°50′	10°50′	37	70	—	10	15	18	20
945	—	3 miles WNW. of Sjællands Rev L.	56°6′	11°8′	31	70		65	8	12	18
951	22/6	9 miles E. by N. of Udbyhøj	56°38′	10°33′	12	25	—	1	..	8	..
955	23/6	1.8 miles SE. by E. of Hals Barre L.	56°56′	10°29′	12	30	—	1	..	14	..
	1929										
1387	4/4	6 miles E. of Fyens Hoved	55°39′	10°46′	36	100—60—20	30	4	4	5	5
1388	—	2.5 miles WNW. of Vestborg L.	55°47′	10°29′	32	65—20	20	3	3	4	4
1389	5/4	1 mile E. of Tunø Røn	55°58′	10°30′	39	90—60—20	30	25	3	4	5
1391	6/4	1.5 miles N. of Æbelø	55°40′	10°10′	22	50—20	20	12	3	3	4
1393	10/4	2 miles W. of Lyø	55°2′	10°5′	37	90—60—20	30	8	3	4	4
1394	—	4 miles ESE. of Pøls Huk	54°52′	10°11′	32	80—50—20	—	22	3	4	5
1397	12/4	2 miles ENE. of Kjelsnor L.	54°45′	10°47′	27	60—40—20	—	1	..	6	..
1398	—	2.5 miles SE. of Tranekær L.	54°58′	10°56′	42	60—20	20	1	..	6	..
1400	16/4	4 miles N. by W. of Refsnæs	55°49′	10°49′	41	100—60—20	30	19	4	..	8
1401	—	4.5 miles NNW. of Sejrø Light	55°59′	11°2′	39	100—60—20	—	44	4	..	8
1402	—	2.5 miles NW. of Sjællands Rev	56°6′	11°10′	42	100—60—20	—	168	4	..	7
1403	—	9 miles WSW. of Hesselø	56°7′	11°30′	22	50—20	20	48	3	..	6
1404	17/4	1.5 miles N. by W. of Bramsnæs	55°43′	11°49′	7	15	10	1	..	4	..
1405	—	5 miles SSW. of Hundested	55°53′	11°50′	9	20	—	4	4	4	6
1407	22/4	3 miles SE. of Helleholm Light	55°9′	11°17′	32	75—50—20	30	83	4	..	8
1408	—	3 miles SW. of Karrebæksminde	55°8′	11°35′	12	30—20	20	21	4	..	7
1409	—	2.5 miles WSW. of Knudshoved	55°4′	11°33′	13	30—20	--	9	5	..	7
1410	25/4	Taarbæk Rev	55°47′	12°39′	7	15	10	15	4	..	7
1411	—	Nivaa Flak	55°55′	12°35′	7	15		19	4	5	5
1413	27/4	2 miles SE. of Taarbæk Rev	55°46′	12°43′	14	20	-	13	4	..	7
1414	—	5 miles S. of Hveen	55°49′	12°44′	22	55—20	20	30	4	..	8
1415	—	1 mile N. of Hveen	55°56′	12°41′	30	80—20	--	32	4	..	8
1416	28/4	1.5 mile NNW. of Hornbæk	56°7′	12°26′	7	20	10	10	4	..	8
1417	—	2.5 mile W. of Höganäs	56°12′	12°28′	24	60—20	20	6	4	..	5
1418	—	7 miles E. by S. of Kullen	56°18′	12°39′	18	50—20	—	15	4	..	8
1419	—	6.5 miles ENE. of Kullen	56°21′	12°37′	19	55—20	-	15	4	..	6
1420	—	11 miles NW. by N. of Kullen	56°27′	12°15′	35	100—60—20	30	13	4	..	8
1421	—	7 miles W. of Kullen	56°17′	12°15′	29	75—20	20	7	4	..	8
1422	—	2 miles N. of Gilleleje Havn	56°10′	12°18′	15	35	10	15	4	..	8
1423	29/4	1.5 miles N. of Klintebjerg	55°59′	11°35′	13	30	—	5	4	..	6
1425	—	2 miles N. by W. of Spodsbjerg	56°1′	11°51′	10	25	—	7	5	5	5
1426	—	1.5 miles W. of Jægerspris	55°51′	11°56′	8	20	--	2	4	5	5
1427	—	2 miles N. of Ourø	55°50′	11°48′	9	20		8	4	..	5
1429	3/5	1.5 miles SE. of Lysegrunden	56°17′	11°49′	19	50—20	20	29	4	..	8
1430	—	16 miles E. by S. of Fornæs Light	56°26′	11°27′	28	75—20		9	4	..	9

Table I (continued).

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m.	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1929										
1431	3/5	7.5 miles W. by N. of Anholt Havn	56°43′	11°18′	18	50—20	20	7	5	..	9
1432	4/5	5 miles NE. of Store Middelgrund.....	56°37′	12°12′	53	100—60—20	30	17	5	..	16
1433	—	7.5 miles ESE. of Anholt Knob L. V....	56°44′	12°5′	40	100—60—20	—	8	5	..	17
1434	—	2.5 miles E. of Anholt Knob L. V.	56°46′	11°56′	43	100—60—20	..	5	4	6	7
1435	—	1.5 miles S. of Lille Middelgrund	56°56′	11°56′	17	45—20	20	5	7	9	15
1436	—	9 miles WNW. of Lille Middelgrund	57°0′	11°42′	69	100—60—20	30	11	4	..	9
1437	—	7 miles NW. by N. of Anholt Knob L.V.	56°53′	11°46′	58	100—60—20	—	4	5	..	12
1438	—	2 miles NW. of Anholt Light	56°45′	11°36′	10	25	10	3	6	7	8
1439	—	2.5 miles N. by E. of Anholt Havn.....	56°46′	11°31′	8	20	—	13	5	..	11
1440	5/5	10 miles ESE. of Hals Barre.....	56°55′	10°43′	10	20	—	14	6	..	11
1443	6/5	1.5 miles E. of Agger Sund.....	57°1′	9°20′	5	15	—	1	..	7	..
1452	8/5	3 miles ESE. of Hals.....	56°57′	10°24′	7	15	—	26	5	..	16
1453	—	8 miles N. by E. of Als Odde.....	56°51′	10°21′	6	15	—	123	5	..	19
1454	—	3 miles E. of Als Odde.....	56°44′	10°25′	5	10	—	5	9	12	15
1457	9/5	3 miles E. of Udbyhøj	56°36′	10°24′	7	20	—	27	5	..	15
1458	—	3.5 miles NW. of Gjerrild Light.....	56°34′	10°45′	8	20	—	88	6	..	22
1459	—	3.5 miles S. of Fornæs Light.....	56°23′	10°59′	12	30	—	11	7	..	25
1460	—	1 mile S. of Jernhatten.....	56°14′	10°48′	25	70—20	20	142	5	..	13
1461	—	1.5 miles NW. of Kyholm	55°57′	10°39′	13	30	10	108	5	..	15
1462	10/5	3.5 miles NW. of Sejrø Light	55°57′	11°0′	48	100—60—20	30	251	4	..	12
1463	—	2.5 miles NW. of Sjællands Rev L.....	56°7′	11°9′	34	90—60—20	—	105	5	..	14
1464	—	1 mile E. of Snekkeløbet	56°3′	11°18′	18	50—20	20	15	4	..	15
1465	—	2 miles WSW. of Snekkeløbet.....	56°1′	11°13′	16	40—20	—	76	5	..	14
1466	—	4 miles N. of Ordrup Næs.....	55°55′	11°21′	12	30	10	33	5	..	15
1467	11/5	2.5 miles NE. of Ballen	55°51′	10°41′	19	50—20	20	16	5	..	12
1468	—	2.5 miles N. of Issehoved.....	56°3′	10°33′	49	100—60—20	30	598	6	..	15
1470	—	N. of Ringebjerg Sand.....	55°53′	10°31′	7	15	10	5	6	7	10
1471	—	2 miles S. by E. of Vestborg Light.....	55°45′	10°34′	15	40	—	49	4	..	15
1472	—	1 mile E. of Sæbbesborg Klint.....	55°36′	10°41′	12	30	—	106	5	..	15
1473	12/5	1.3 miles SE. by E. of Kerteminde.....	55°27′	10°42′	13	30	—	12	5	..	15
1474	—	2.3 miles SE. of Romsø	55°30′	10°52′	32	80—60—20	30	67	6	..	15
1475	—	1.5 miles E. by S. of Teglgaardsskov ...	55°20′	10°51′	20	50—20	20	33	4	..	12
1476	23/5	1.5 miles NNE. of Egholm.....	55°16′	11°12′	34	80—60—20	30	18	6	..	9
1477	—	3.5 miles SE. by S. of Helleholm L.....	55°8′	11°17′	28	70—20	20	2	9	11	12
1478	—	E. of Venegrunden	55°6′	11°30′	10	25	10	6	6	10	13
1480	—	1 mile N. of Knudshoved (Sjælland) ...	55°6′	11°37′	8	20	10	1	..	13	..
1481	—	2.5 miles S. of Knudskov	55°00′	11°44′	8	20	—	1	..	9	..
1490	25/5	1.2 miles SE. of Raagø	54°57′	11°20′	7	20	—	2	10	12	13
1491	—	3 miles NW. by N. of Onsevig.....	54°59′	11°4′	8	20	—	7	5	7	10
1492	—	3 miles NE. of Tranekær Light	55°1′	10°58′	15	40	—	1	..	6	..
1493	—	2.5 miles SSE. of Hov Light.....	55°6′	10°59′	22	60—20	20	6	6	8	13
1494	—	2.5 miles NE. of Hov Light	55°11′	11°00′	7	15	10	2	7	8	8
1495	—	1.5 miles S. of Sprogø.....	55°18′	10°59′	18	45—20	20	7	6	8	13
1497	26/5	1.5 miles SE. of Vresen.....	55°12′	10°56′	13	30	10	18	6	..	9
1500	—	S. of Thurø Rev.....	55°1′	10°42′	11	20	—	1	..	12	..
1501	—	2 miles S. of Slipshavn.....	55°15′	10°50′	10	20	—	1	..	12	..
1502	27/5	3 miles S. of Spodsbjerg.....	54°53′	10°51′	31	70—20	20	21	5	..	12
1503	—	11 miles W. by N. of Rødby Havn.....	54°43′	11°3′	12	25	10	11	5	6	7
1504	—	1.5 miles N. of Femern Belt L. V.....	54°37′	11°9′	26	70—20	20	18	5	..	10
1505	—	3.5 miles W. of Rødby Havn	54°39′	11°15′	13	30	10	21	5	6	7
1507	28/5	2 miles SE. of Kjelsnor Light.....	54°43′	10°46′	26	70—20	20	4	7	8	10
1508	—	4 miles W. of Gulstav.....	54°43′	10°35′	26	70—20	20	23	4	..	12
1509	—	2.5 miles SE. by S. of Marstal.....	54°49′	10°35′	14	30	10	6	5	..	7

Table I (continued).

Station No.	Date	Locality	Central Position N.	Central Position E.	Depth in m	Depth of fishing or wire-length in m.	Duration of fishing, minutes	No. of larvae caught	Length in mm. minimum	Length in mm. average	Length in mm. maximum
	1929										
1510	28/5	4.5 miles SW. by W. of Vejsnæs Nakke.	54°46′	10°20′	25	70—20	20	2	..	19	..
1511	—	9 miles S. of Pøls Huk	54°44′	10°5′	20	50—20	—	13	8	..	21
1512	29/5	1.5 miles SSW. of Sønderborg	54°53′	9°46′	26	70—20	—	1	..	4	..
1513	—	4.5 miles SE. of Sønderborg	54°51′	9°53′	12	25	10	2	..	..	.
1514	—	3 miles SE. of Kegenæs	54°50′	10°4′	7	15	—	1	..	27	..
1515	—	4 miles S. by E. of Skjoldnæs L.	54°55′	10°14′	24	65—20	20	9	8	12	17
1516	—	1.5 miles ESE. of Skjoldnæs L.	54°58′	10°16′	17	45—20	—	2	4	13	21
1518	—	1.5 miles E. of Taksensand L.	55°1′	10°1′	36	100—60—20	30	49	6	..	19
1519	—	1 mile S. of Helnæs	55°6′	10°3′	12	25	10	5	7	15	24
1520	—	2 miles ENE. of Nordborg L.	55°6′	9°46′	27	75—20	20	1	..	17	..
1522	30/5	1 mile N. of Varnæs Hoved	55°4′	9°35′	34	90—60—20	30	2	15	20	25
1523	—	1.5 mile S. by W. of Halk Hoved	55°11′	9°41′	24	60—20	20	1	..	5	..
1524	—	5 miles SSW. of Assens	55°12′	9°51′	13	30	10	2	18	20	22
1526	—	1 mile NNW. of Baagø	55°20′	9°47′	8	20	—	1	..	6	..
1527	—	0.5 mile S. of Stenderup Hage	55°27′	9°42′	8	20	—	7	5	8	15
1528	—	1 mile NW. of Fænø	55°30′	9°39′	14	30	—	4	5	12	20
1529	31/5	1 mile NE. of Fredericia	55°34′	9°48′	8	20	—	40	5	12	24
1530	—	Baaring Vig	55°32′	9°53′	12	30	—	5	7	9	12
1531	—	2 miles NE. of Kasserodde	55°40′	9°54′	14	35	—	3	4	12	21
1533	—	2 miles SE. of Hjarnø	55°49′	10°9′	7	15	—	2	12	13	14
1534	—	2.3 miles NE. of Endelave	55°48′	10°23′	9	20	—	3	16	19	24
1536	1/6	2 miles NE. by N. of Issehoved	56°2′	10°35′	8	20	—	11	11	16	20
1537	—	1.3 miles WSW. of Sletterhage	56°5′	10°29′	24	60—20	20	17	12	16	21
1539	—	1.8 miles SW. of Hjelm	56°7′	10°46′	28	75—20	—	10	9	16	22
1540	—	5 miles NE. by E. of Issehoved	56°3′	10°41′	23	60—20	—	7	15	18	25
1542	—	1.5 miles NE. by E. of Staalhøj Hage	55°53′	10°44′	21	55—20	—	19	8	12	16
1543	2/6	4 miles N. by W. of Refsnæs	55°48′	10°49′	35	75—50—20	30	7	9	15	22
1548	5/6	1.5 miles NW. of Romsø	55°32′	10°45′	9	20	10	4	11	18	25
1549	—	5 miles SSE. of Stavreshoved	55°24′	10°50′	19	50—20	20	2	16	18	19

Table II, A. Measurements of Length af O-Group of Cod fro

O. = Otter Trawl, (with finemeshed Codend), Y. =Petersens' Young Fish Trawl, T. = Tog, P. = Johanse

	North Sea and Skagerak														The Limfjord					
Date	30/7-8/8 1912	3-4/8 1912	7/8 1912	20/8 1912	27-31/8 1909	10/9 1909	14/9 1922	21-22/9 1905	29-30/9 1904	30/9 1904	4/10 1904	14-20/10 1925	15/11 1904	24/11 1904	25-29/6 1928	18/7 1913	25/7 1896	3/8 1896	5/8 1912	12- 19
Locality	Sønderho-Blaavands-huk	Blaavands-huk-Thyborøn	Agger-Hanstholm	Hanstholm-Skagen	Fanø-Hanstholm	Fanø-Hanstholm	Horns Reef Area	W. of Thyborøn	Horns Reef Area	Horns Reef Area	NW. of Thyborøn	Horns Reef Area	Esbjerg-Skallingen	Esbjerg-Skallingen	W. of Løgstør	Nissum Broad	Sallingsund	Holmeflak	Nissum Broad	W. of
Depth, m.	1-4	2-9	1-5	1-5	1-5	2-5	30-49	12	15-31	15-17	31	9-49	9-13	5-13	6-15	1-4	10	5	1-3	7-1
Fishing-gear	P.	P.	P.	P.	P.	P.	O.	O.	O.	Y.	Y.	O.	F. B.	F. B.	T.	P.	?	?	P.	T
cm.																				
3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	13	2	9	..	..	..	..	..	..	..	..	..	..	..	5	..	..	..	1	..
5	17	5	14	2	..	..	..	..	..	2	1	..	..	..	24	4	4	2	5	..
6	40	9	19	18	4	4	..	..	..	..	7	..	..	..	32	7	4	5	6	8
7	15	7	32	35	26	6	..	..	1	8	11	..	1	..	29	9	9	9	6	18
8	6	4	33	27	19	5	10	1	3	8	14	1	..	2	6	6	3	11	3	56
9	6	2	26	6	17	5	5	8	1	8	9	2	3	..	..	9	..	..	2	33
10	3	1	13	3	8	..	20	22	4	10	9	10	1	2	..	1	..	..	1	25
11	..	2	..	5	5	..	17	35	2	2	4	24	1	6	..	1	..	..	1	16
12	..	..	1	1	1	..	14	41	8	2	2	37	3	4	..	1	..	..	..	9
13	..	..	1	1	..	..	8	42	6	..	2	40	3	..	..	..	..	..	..	1
14	..	..	..	..	..	..	5	22	4	..	1	40	4	4	..	..	..	..	..	3
15	..	..	..	..	..	..	3	20	1	..	..	28	9	3	..	..	..	..	..	1
16	..	..	..	..	..	..	1	2	..	..	..	20	7	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	14	7	6	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	11	8	3	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	4	4	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	2	..	7	..	..	..	..	..	..
21	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
22	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..
Total number	100	32	148	98	80	20	83	193	30	40	60	233	51	41	96	38	20	27	25	208
Aver. length, cm.	6.1	6.8	7.4	7.6	8.2	7.6	11.0	12.2	11.6	8.7	8.6	13.8	15.1	15.5	6.1	7.6	6.6	7.1	6.9	8.8

Date	4/8 1925	14/8 1904	2/7 1919	9/7 1919	11/7 1929	17/7 1905	18/7 1924	18-21/7 1905	21/7 1905	23/7 1929	24-25/7 1928	28/7 1928	31/7 1928	4/8 1904	4/8 1904	4-5/8 1928	11-12/8 1928	14/8 1919	18/8 1904	27/ 191
Locality	Ebeltoft-Vig	NW. of Fænø	Flækøjet	E. of Vresen	Southern Belt Sea	Stokkebæk Flak	Kalø Vig	Northern Belt Sea	Kerteminde Bay	Smaalands-havet	E. and N. of Als	S. of Fyen	Northern Belt Sea	W. of Ærø	W. of Ærø	Samsø Belt	Smaalands-havet	Pale-grunden	Flækøjet	Northern Belt Sea
Depth, m.	4-6	6	c. 10	14	6-13	12	9	12-16	c. 10	12-15	31-38	5-9	5-20	c. 38	c. 10	26-33	5-15	c. 15	10	11
Fishing-gear	T.	Y.	T.	T.	T.	Y.	T.	Y.	Y.	T.	T.	T.	T.	Y.	Y.	T.	T.	T.	Y.	O.
cm.																				
3	..	13	..	..	..	1	..	3	2	..	..	..	..	..	..	..	..	..	..	..
4	10	4	..	..	2	4	..	19	7	..	..	..	..	9	..	..	..	..	..	..
5	10	2	2	..	4	3	1	9	4	1	11	6	3	17	1	4	1	..	1	..
6	..	..	6	1	1	..	2	3	1	7	11	9	15	4	6	20	9	..	..	..
7	..	..	4	12	..	..	1	4	3	3	5	10	41	..	2	26	29	..	..	1
8	..	..	2	29	..	..	2	1	..	5	2	8	30	..	3	12	29	1	5	..
9	..	..	1	17	..	..	1	1	..	..	..	10	15	..	1	8	27	6	11	..
10	..	.	1	13	.	..	..	1	..	..	..	1	3	..	..	2	13	3	2	2
11	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	6	10	1	9
12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2	2	7
13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	11
14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	2
15	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total number	20	19	16	72	7	8	7	41	17	16	29	46	107	30	13	72	119	22	22	32
Aver. length, cm.	4.5	3.4	6.8	8.4	4.9	4.3	7.0	5.0	4.8	6.8	5.9	7.4	7.4	4.8	6.8	7.1	8.4	10.3	9.0	11.9

e to March at different Localities in the Waters round Denmark.

ng Plaice Trawl, F.B. = Finemeshed Beam Trawl, B. = Bait Seine, H. = Herring Seine, E. = Eel weel.

	Kattegat															Isefjord			The Sound	
	8/7 1909	8-10/7 1928	9-12/7 1928	12/7 1927	4/8 1928	11/8 1907	11-16/8 1929	16-18/8 1929	6/9 1926	6/9 1929	8/9 1925	8/9 1929	13/9 1929	15/9 1922	17/10 1922	11/11 1903	3/8 1928	3-4/8 1928	23/10 1929	27/7 1905	7/9 1925
	SE. of Muldbjerge	Læsø Rende Skagen	Læsø Rende Skagen	Aalbæk Bay	Off Hundested	E. b. S. of Skagen L. V.	S. and W. Kattegat	N. and E. Kattegat	Gillcleje Flak	N. of Grenaa	N. of Grenaa	E. b. S. of Als Odde	N. and W. of Læsø	N. of Djursland	Læsø Rende	North Kattegat	Bramsnæs Vig	The great Broad	The great Broad	Off Nivaa	N. of Hven
	7	6-13	20-50	7	13	48	c.10-20	c.20-40	12	4-5	4-5	13	5-17	c. 8	10-11	10	7	7-10	6.5	13	29
	T.	T.	T.	T.	T.	O.	T.	T.	T.	T.	T.	T.	T.	T.	O.	O.	T.	T.	T.	Y.	T.
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	2	..	3	..	..	16	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..
	7	16	16	..	11	17	..	..	..	..	..	..	..	..	..	..	7	133	..	2	..
	13	23	11	1	11	6	2	2	..	..	..	4	..	..	..	..	12	129	..	2	..
	14	39	1	2	38	1	9	27	1	..	..	21	3	..	..	..	7	86	1	..	..
	3	29	..	2	52	..	13	72	..	2	1	79	3	..	..	..	5	80	13	..	..
	..	20	..	2	47	..	20	59	1	3	7	72	10	1	..	3	6	100	27	..	1
	..	3	..	1	31	..	12	16	3	1	10	30	3	5	1	3	5	60	35	..	2
	..	..	..	..	15	..	10	13	4	4	6	12	6	6	3	1	10	45	31	..	2
	..	..	..	..	7	..	2	10	3	3	8	2	5	10	3	2	13	24	30	..	3
	..	..	..	..	2	..	1	7	..	3	10	..	2	6	2	2	10	12	19	..	1
	..	..	..	..	..	..	..	..	1	..	9	..	..	5	1	3	9	2	8	..	..
	..	..	..	..	..	..	..	..	..	..	3	..	..	1	3	4	3	..	5	..	..
	..	..	..	..	..	..	..	..	..	..	2	..	..	1	2	3	..	..	2	..	..
	..	..	..	..	..	..	..	..	..	..	2	..	..	..	1	4	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	3	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	39	130	31	8	214	40	69	206	13	16	59	220	32	35	16	28	87	671	171	7	9
	6.2	7.2	5.3	8.0	8.5	4.8	9.1	8.8	10.8	10.7	12.2	8.7	9.9	12.1	13.3	13.9	10.0	7.7	10.9	4.9	11.1

Sea

	9/9 1925	13/9 1926	19/9 1924	27/9 1929	4/10 1918	4-5/10 1929	6/10 1927	6/10 1905	6-9/10 1929	12/10 1904	17/10 1906	22/10 1906	23-24/10 1908	23-24/10 1908	21/12 1908	14-24/1 1905	2/2 1904	5-7/2 1905	22/2 1904	30/3 1905
	W. of Vresen	SE. of Fyen	Brandsø Broad	NNW. of Kyholm	SE. of Vresen	N. of Fyen	N. of Kyholm	Flækøjet	Southern Little Belt	Baaringvig	Fænø Sound	Baaringvig	Northern Great Belt	Southern Great Belt	Nyborg Fjord	Nyborg Fjord	Nyborg Fjord	Nyborg Fjord	Nyborg Fjord	S. of Fyen
	11	c. 10	10	12	12	13-21	13	10	14-34	5	< 10	6	4-19	4-19	10	c. 10	c. 5	c. 10	c. 5	c. 10
	T.	T.	T.	T.	T.	T.	T.	Y.	T.	Y.	E.	Y.	T.	T.	H.	H.	B.	H.	B.	H.
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	1	..	..	2	..	3	..	..	..	..	1	..	1	..	..	..	..	..	.	..
	1	3	..	9	..	9	..	..	4	..	..	1	3	2	..	..	..	..	..	..
	3	1	5	43	..	34	12	4	2	1	1	5	14	6	..	..	.	..	..	..
	4	1	6	46	..	43	28	5	..	2	5	3	14	9	..	..	..	..	1	..
	1	2	5	45	1	34	44	11	2	3	6	..	18	12	..	.	7	1	3	..
	1	..	3	17	2	16	33	8	2	8	11	1	18	11	..	4	22	11	9	2
	..	1	..	6	1	11	12	6	1	11	7	..	7	14	2	5	21	18	19	2
	..	..	..	1	2	1	9	8	..	6	3	..	6	16	3	8	28	32	19	5
	..	..	..	..	1	..	2	..	..	6	4	1	4	12	5	11	15	31	20	22
	..	..	..	..	1	..	2	1	..	6	3	..	..	10	3	7	16	29	18	29
	..	..	..	..	..	..	4	1	..	3	2	..	1	5	5	9	7	21	18	25
	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	18	5	20	7	32
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	4	6	2	29
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	3	..	27
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	10
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3
	11	8	19	169	8	151	146	44	11	46	43	11	86	99	19	69	126	173	116	222
	8.5	8.8	9.3	9.2	12.4	9.3	10.5	11.0	8.9	12.5	11.5	9.0	10.2	12.0	14.5	15.1	13.2	14.4	13.8	16.7

Table II, A (continued).

	Western Baltic						True Baltic E. of Seeland, Møen and Falster						True Baltic, round Bornholm				
Date	13/7 1911	24/7 1928	27/7 1928	4/8 1904	4/8 1904	25/8 1904	28/6 1927	25/7 1927	13-14/8 1905	13-14/8 1928	27/8 1925	7-8/9 1927	14-24/8 1928	29/8 1928	29/8-2/9 1927	30/8-3/9 1927	28/8-6/9 1927
Locality	Western Baltic	ESE. of Skjoldnæs	SW. of Ærø	SW. of Ærø	SW. of Ærø	S. of Lolland	Off Hestehoved	Off Hestehoved	E. of Falster to 13° E. L.	E. of Falster to 13° E. L.	Tolken	SE. of Stevns	S. and W. of Bornholm	Arkona Basin	Round Bornholm	SE. of Bornholm	Arkona Basin
Depth, m.	6-14	30	25-35	38	10	8.5	18	24	7-12	20-35	8-11	26-31	24-52	43-45	35-90	34-35	c. 40
Fishing-gear	Y.	T.	T.	Y.	Y.	T.	T.	Y.	T.	T.	T.	T.	T.	T.	T.	T.	T.
cm.																	
3	..	..	..	..	..	..	6	1	..	..	..	..	..	..	..	..	..
4	4	3	..	9	..	..	65	4	..	..	..	..	..	..	..	..	..
5	7	20	6	17	1	..	47	2	..	1	..	..	9	..	..	..	..
6	7	24	10	5	6	..	8	1	5	6	1	..	60	9	1	1	..
7	..	16	14	..	2	..	..	..	8	8	..	..	66	13	7	3	2
8	..	8	19	..	3	1	..	..	6	7	10	..	36	18	7	4	3
9	..	7	6	..	1	..	..	..	10	4	8	5	20	10	2	..	1
10	..	3	..	..	..	..	..	..	3	1	5	..	8	4	1	..	1
11	..	..	..	..	..	1	..	..	..	..	1	..	2	..	1	..	..
12	..	..	..	..	..	2	..	..	..	..	2	..	2	1	..	..	..
13	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
15	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total number	18	81	55	31	13	7	126	8	32	27	27	5	203	55	19	8	7
Aver. length, cm.	5.2	6.5	7.2	4.9	6.8	11.9	4.5	4.4	7.9	7.4	9.0	9.0	7.2	7.8	7.9	7.4	8.1

Table II, B. Measurements of Length of I-Group of Cod

O. = Otter Trawl, Y. = Petersens' Young Fish Trawl, T. = Tog.

	North Sea and Skagerak							The Limfjord										
Date	6-7/4 1906	30/4 1907	17/4-9/5 1907	20/6 1911	21-22/9 1905	14-27/9 1922	3-5/10 1905	21/4 1921	10/5 1917	22/5 1917	9/7 1909	10/7 1909	3/8 1896	22/9 1921	28/4-1/5 1926	28/4-1/5 1926	22-23/6 1928	7-13/7 1928
Locality	Horns Reef	Horns Reef	Off the W.-coast of Jutland	Off Thyborøn	Off Thyborøn	Horns Reef	Tannis Bay	Sallingsund	Thisted Broad	Hvalpsund	W. of Løgstør	Thisted Broad	Holmeflak	Thisted Broad	North Kattegat	South Kattegat	South-West Kattegat	North Kattegat
Depth, m.	16-37	11-24	c.10-50	16	12	c.10-35	13-70	c. 20	c. 7	6-20	4-5	c. 10	c. 6	c. 10	c.20-60	c.20-30	4-6	6-18
Fishing-gear	O.	O.	O.	O.	O.	O.	O.	T.	P.	T.	T.	T.	?	T.	O.	O.	T.	T.
cm.																		
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	1	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
10	1	6	14	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
11	2	10	2	..	..	..	..	..	..	1	..	..	..	..	1	1	..	..
12	5	13	9	1	..	..	..	..	..	1	4	..	..	..	5	3	..	..
13	4	11	8	3	..	..	..	..	..	21	49	3	..	..	1	4	..	1
14	1	9	2	3	2	..	..	..	..	23	73	4	..	..	1	3	..	..
15	1	10	6	8	1	..	..	..	1	36	83	7	..	..	1	7	2	..
16	..	6	9	13	6	..	..	1	4	35	109	10	3	..	2	6	1	1
17	..	6	3	7	4	..	..	4	9	21	73	19	4	..	3	3	1	4
18	..	1	2	7	19	..	..	2	12	19	53	22	4	..	..	7	2	7
19	..	2	2	6	44	..	4	1	11	9	32	28	5	..	2	7	..	12
20	..	2	2	5	50	3	1	4	9	5	17	38	3	1	1	9	2	11
21	..	1	..	8	79	2	4	4	17	3	14	39	1	..	..	6	1	7
22	..	1	..	3	102	3	2	3	20	1	10	30	2	1	..	2	..	8
23	..	..	..	2	121	3	1	1	18	2	10	26	..	3	1	..	2	3
24	..	..	3	2	75	7	5	3	13	..	16	22	..	4	2	..	..	2
25	..	..	..	4	69	3	6	..	10	..	2	18	..	3	..	..	2	2
26	..	..	..	1	61	5	5	2	6	2	4	21	..	1	..	..	1	..
27	..	..	..	1	41	5	1	1	1	..	3	11	..	3	..	..	..	1
28	..	..	..	..	27	2	4	..	1	..	..	6	..	3	..	..	..	..
29	..	..	..	..	29	2	4	..	..	..	1	3	..	3	..	..	..	..
30	..	..	..	..	12	2	1	..	..	..	..	2	..	2	..	..	..	..
31	..	..	..	..	13	..	1	..	1	..	..	..	..	1	..	..	..	..
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42	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Total number	15	79	64	74	798	41	45	26	133	179	553	309	22	25	21	58	14	59
Average length, cm.	12.1	13.8	13.9	18.4	24.0	25.8	26.0	20.9	21.4	16.0	16.7	21.3	18.5	26.0	16.0	17.3	20.1	20.1

t different Localities in the Waters round Denmark.

. · = Eel Weel, P. = Pound Net, E.S. = Eel Hand-Seine.

Kattegat								Isefjord				The Sound							
-13/7 1928	4/8 1928	11-16/8 1929	6-18/8 1929	6/9 1929	10-13/9 1929	15/9 1922	10-28/10 1905	22/6 1920	5/7 1924	1-8/8 1929	23/10 1929	26-27/6 1924	27/8 1924	10/7 1912	27/7 1929	29/7 1929	31/7 1924	1/8 1924	3/9 1926
North Kattegat	South Kattegat	South and West Kattegat	North Kattegat	NE. of Grenaa	North Kattegat	SE. of Hals	North Kattegat	Great Broad	Great Broad	Great Broad	Great Broad	Køge Bay	Lomma Bay	Off Snekkersten	Køge Bay	N. of Hven	E. of Taarbæk Reef	Køge Bay	Køge Bay
0-41	13	4-37	4-40	4	5-29	c. 14	10-32	9	5-9	7-10	4-7	13-14	16	c. 7	11	5-23	16-18	14	11
T.	T.	T.	T.	T.	T.	T.	O.	T.	T.	T.	T.	T.	T.	P.	T.	T.	T.	T.	T.
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1	..	..	9	4	3	..	..	..	2	41	..	..	2	..	3	1	2	4	..
1	..	1	9	2	3	..	2	..	..	54	2	..	..	..	8	..	4	3	..
1	3	2	16	2	9	..	..	1	1	52	3	..	1	..	16	3	1	3	..
2	8	3	8	4	7	..	2	1	6	26	4	..	..	1	15	2	3	1	..
4	5	8	15	1	11	1	..	3	1	11	6	1	..	1	15	4	1	..	1
1	10	5	27	7	13	..	4	3	1	9	7	2	2	2	12	6	..	..	1
2	11	4	17	3	11	4	8	5	5	8	7	1	1	4	11	4	1	2	3
..	9	7	7	3	6	2	3	6	2	4	12	3	2	5	1	4	3	..	3
..	5	1	8	1	7	4	7	9	..	5	11	1	..	7	3	7	3	..	6
1	8	3	3	1	5	1	5	7	4	3	5	2	..	2	..	2	..	..	4
..	4	1	8	2	7	4	6	7	1	1	9	..	..	..	..	2	..	..	4
..	1	..	1	2	1	1	7	5	..	1	3	..	..	..	..	3	..	..	..
1	..	..	5	1	1	1	7	6	1	..	1	..	..	..	..	1	..	..	1
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17	64	35	136	36	87	18	61	57	24	243	70	10	14	22	84	40	18	20	23
9.7	22.1	21.4	20.8	21.3	21.7	24.1	25.2	24.6	21.9	18.0	22.8	22.7	17.1	22.8	19.5	22.6	19.9	16.3	24.0

Table II, B (continued).

Date	3-6/4 1929	11/4 1924	16/4 1912	26/4 1922	5/5 1912	9/5 1926	9/5 1906	8-10/5 1926	19/5 1915	16-21/5 1928	16-22/5 1928	26/5 1908	1/6 1908	4/6 1925	9-13/6 1928	12/6 1917	15/6 1900	2/7 1919
Locality	Northern Belt Sea	Nyborg Fjord	Off Slipshavn	Nyborg Fjord	Vejle Fjord	Aabenraa Fjord	Nyborg Fjord	Southern Belt Sea	Off Holckenhavn	Northern Belt Sea	Northern Belt Sea	Kerteminde Bay	Off Tidselholt	Ebeltoft Vig	Southern Belt Sea	Off Lundeborg	Nyborg Fjord	Flækojet
Depth, m.	3-4	c. 6	c. 3	c. 6	8	33	c. 3	20-36	c. 6	11-20	20-58	4	3	5-9	20-40	c. 14	3	c. 8
Fishing-gear	T.	T.	E.	T.	T.	O.	E. S.	O.	P.	T.	T.	E. S.	E. S.	T.	T.	T.	E. S.	T.
cm.																		
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	..	1	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..
9	2	1	..	3	..	..	..	..	..	4	2	..	..	..	..	..	..	..
10	2	2	..	3	..	..	..	..	..	9	2	..	..	..	..	..	..	..
11	7	3	..	2	..	1	..	1	..	11	10	..	..	..	10	..	..	..
12	12	10	1	8	..	4	..	3	..	5	14	3	..	..	16	..	..	..
13	5	14	2	7	..	7	..	13	1	6	8	6	..	4	18	..	4	..
14	9	17	2	6	1	33	1	14	..	5	8	15	..	2	23	1	6	..
15	4	17	1	4	1	33	1	52	1	3	5	20	2	5	16	2	12	..
16	2	20	2	4	3	33	3	48	1	2	6	26	4	5	16	2	14	..
17	4	27	2	2	4	10	1	44	1	1	10	25	3	1	10	1	21	..
18	..	16	2	..	1	3	3	33	3	..	..	27	1	4	14	1	8	3
19	..	7	..	2	3	1	2	16	7	..	..	24	3	2	5	4	18	1
20	..	5	1	..	2	1	5	8	3	..	1	14	5	..	1	..	18	2
21	..	4	1	..	..	..	7	1	8	..	..	11	1	..	4	3	10	1
22	..	2	..	..	..	..	2	1	2	2	..	1	1	..	..	2	11	6
23	..	1	..	..	..	..	6	..	1	..	..	..	1	..	1	2	4	2
24	..	..	..	..	..	..	..	1	1	1	..	..	1	..	..	3	11	2
25	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	2	6	1
26	..	..	..	..	..	..	1	..	..	..	..	..	1	..	..	..	4	..
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39	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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41	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
42	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total number	47	147	14	41	15	126	36	235	29	50	67	172	23	23	137	25	147	18
Average length, cm.	13.0	15.8	16.0	13.3	17.3	15.1	20.6	16.3	19.6	12.5	13.4	17.1	19.0	15.7	14.8	20.7	19.1	21.4

a

[illegible]/7	8-10/7	11 12/7	8-16/7	16/7	18/7	24-25/7	23-28/7	30/7-5/8	31/7-5/8	14/8	16/8	27/8	5/9	17/9	19/9	27/9	4/10	17-18/10	17/11
919	1929	1929	1911	1892	1924	1928	1928	1928	1928	1919	1920	1924	1924	1919	1924	1929	1918	1906	1915
[illegible] Vresen	Northern Belt Sea	Southern Belt Sea	Northern Belt Sea	Fæno Sound	Kalo Vig	Southern Belt Sea	Southern Belt Sea	Northern Belt Sea	Northern Belt Sea	Nyborg Fjord	Nyborg Fjord	N. of Fyen	Ebeltoft Vig	E. of Vresen	Brandsø Broad	NNW. of Kyholm	SW. of Vresen	Fæno Sound	Nyborg Fjord
-13	5 18	6-13	6-30	c. 3	9-12	20-40	5-20	11-20	20-58	8-14	c. 6	10-20	3-4	c. 10	c. 15	12	8-12	c. 3	c. 3
T.	T.	T.	O.	E.	T.	T.	T.	T.	T.	T.	T.	T.	T.	T.	T.	T.	T.	E.	E. S.
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..	4	4	3	1	4	13	..	7	8	..	..	1	..	..	5	6	..	..	..
..	4	9	1	8	6	34	2	21	9	..	..	2	4	..	6	1	2	..	..
1	3	7	5	4	5	44	1	11	7	..	..	2	2	..	7	3	..	..	..
2	3	7	2	30	1	55	6	26	2	..	..	1	3	..	4	9	3	1	..
1	3	11	4	20	3	35	5	16	4	1	1	1	6	..	3	4	13	3	..
6	1	9	6	64	1	25	21	8	5	2	3	3	1	..	3	..	18	5	..
9	1	6	5	30	1	9	12	9	5	1	4	..	1	..	2	1	15	6	..
11	..	2	4	12	1	..	13	14	3	4	6	1	2	..	1	3	24	5	..
6	..	2	5	15	2	1	13	11	1	6	5	1	1	1	1	2	23	3	..
9	..	..	5	3	1	..	11	1	3	2	3	1	..	5	..	..	12	..	..
10	..	..	2	..	..	..	5	1	1	5	..	1	..	1	..	2	4	3	..
3	..	..	1	..	..	1	4	3	1	1	..	..	2	1	..	..	5	1	5
4	..	..	..	..	..	..	1	..	..	..	..	..	1	2	..	..	7	..	2
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62	19	61	45	187	31	225	105	144	56	22	22	14	26	23	38	31	135	27	15
1.8	16.2	17.2	19.4	18.9	16.2	16.7	21.5	17.4	17.2	22.0	20.9	18.4	18.5	26.2	16.1	17.5	21.5	20.5	27.7

Table II, B (continued).

	Western Baltic					E. of Seeland and Møen		True Baltic, round Bornholm								
Date	8-11/5 1926	14/6 1928	13-14/7 1911	26-27/8 1928	26/7 1928	7-13/5 1928	4/6 1926	19-20/4 1925	23-26/7 1925	1/8 1925	24/7-3/8 1907	3/8 1907	7/8 1926	17-24/8 1928	14-29/8 1928	30/8-3/9 1927	28/8-4/9 1927
Locality		S. of Als	S. and W. of Ærø	S. and E. of Als	Hørup Hav	Hjelms Bay	Faxe Bay	W. and S. of Bornholm	Round Bornholm	Rønne Bank	Round Bornholm	Arkona Basin	S. of Rønne	Round Bornholm	Arkona Basin	S. of Bornholm	Arkona Basin
Depth, m.	23-27	20-35	6-25	20-35	15-17	7-23	11	36-46	36-64	16-35	40-90	20-40	34-42	31-42	34-35	c. 35	c. 40
Fishing-gear	O.	T.	Y.	T.	T.	T.	T.	T.	T.	T.	O.	O.	T.	T.	T.	T.	T.
cm.																	
6	..	..	..	..	..	..	..	2	1	..	..	..	..	..	..	..	..
7	..	..	..	..	..	1	..	1	1	1	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	1	5	2	..	..	..	..	..	..	..
9	..	..	..	..	..	1	..	2	4	5	..	..	..	..	..	..	..
10	..	1	..	..	..	5	..	2	5	4	..	..	..	..	..	..	..
11	2	8	..	1	..	9	..	..	11	4	1	1	4	1	..	1	..
12	5	14	..	2	..	9	..	1	8	4	2	2	12	..	..	1	1
13	10	14	1	3	..	3	1	..	5	6	2	1	14	2	..	1	3
14	10	9	1	3	..	1	..	..	2	1	3	1	13	1	..	5	1
15	17	3	1	3	1	3	3	..	..	..	3	1	18	5	2	1	1
16	15	1	3	7	3	..	2	..	1	..	9	3	19	1	1	..	1
17	11	..	1	3	8	..	5	..	..	1	3	..	10	..	2	2	1
18	11	..	..	3	15	..	2	..	..	..	3	..	3	..	1	1	..
19	8	..	..	3	12	..	1	..	..	..	2	..	..	..	..	1	1
20	5	..	1	..	10	..	2	..	..	..	..	..	..	1	1	..	..
21	..	..	1	..	9	..	..	..	..	..	..	..	..	..	2	..	..
22	1	..	..	..	6	..	1	..	..	..	..	..	..	..	1	..	..
23	..	..	1	..	4	..	..	..	..	..	..	..	..	..	1	..	..
24	1	..	..	..	1	..	..	..	..	..	..	..	..	1	1	..	..
25	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..
26	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
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32	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
33	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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36	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
37	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
38	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
39	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
40	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
41	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
42	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total number	96	50	10	28	76	32	17	9	43	28	28	9	97	12	12	13	9
Aver. length, cm.	15.9	12.7	17.1	15.5	20.0	11.6	17.2	8.6	10.8	11.0	15.5	13.9	14.3	15.5	19.1	14.8	14.7

Table II, C. Measurements of Length of II-Group of Cod at different Localities in the Waters round Denmark.

O. = Otter Trawl, T. = Tog, E. = Eel Weel, E. S. = Eel Hand Seine, D. S. = Danish Seine, H. = Hooks.

	North Sea and Skagerak					The Limfjord		Kattegat								
Date	2-9/4 1906	16/4-7/5 1907	14-27/9 1922	21-23/9 1905	4/10 1905	16/5 1895	19/8 1910	7/4 1922	4-9/5 1927	20-25/5 1927	6-12/7 1927	6-18/8 1929	28-29/8 1913	3/10 1906	10-28/10 1905	22/4 1920
Locality	Off the W.-coast of Jutland	Off the W.-coast of Jutland	Horns Reef Area	2 miles W. of Thyboron	Tannis Bay	Sallingsund	E. of Mors	NE. of Hals	S. W.-Kattegat	Southern Kattegat	NE. of Hals	NW.-Kattegat	At Schultz' Grund	Læsø Trindel	North Kattegat	Great Broad Isefjord
Depth, m.	37-51	10-40	30-49	12	15	c. 4	c. 8	c. 8	5-19	10-30	6-30	4-40	30	c. 30	20-40	c. 10
Fishing-gear	O.	O.	O.	O.	O.	E.	H.	T.	T.	T.	T.	T.	D. S.	O.	O.	T.
cm.																
20	..	1	..	..	..	..	..	..	..	1	..	..	..	..	..	..
21	..	..	..	..	..	..	..	..	2	2	..	..	..	..	..	..
22	..	..	..	..	..	..	..	..	1	2	..	..	..	..	..	..
23	1	..	..	..	..	..	..	..	3	5	1	..	..	..	1	..
24	1	..	..	..	..	..	..	..	1	6	..	..	..	..	..	..
25	1	..	..	..	..	..	1	..	..	4	..	..	2	..	..	..
26	1	..	..	..	..	..	..	2	3	10	1	..	5	1	..	..
27	3	..	..	..	..	..	3	1	2	10	1	..	4	..	1	..
28	2	..	..	..	..	4	3	1	5	5	1	1	8	1	1	..
29	..	..	..	..	..	7	2	3	1	6	2	..	11	1	1	..
30	..	..	..	..	..	7	3	2	3	4	1	2	19	3	1	..
31	..	2	..	..	..	18	8	1	2	2	4	..	18	2	7	2
32	1	..	..	..	..	14	3	..	..	3	2	3	13	2	3	3
33	..	..	..	..	..	27	7	..	..	3	5	5	8	3	9	4
34	..	1	..	..	..	20	6	..	..	3	1	..	7	3	13	4
35	..	..	..	..	..	23	4	1	..	..	..	..	4	1	10	6
36	1	1	..	..	..	8	2	..	..	1	2	5	6	2	5	8
37	1	1	..	..	1	10	2	..	..	..	2	1	2	2	4	11
38	1	..	1	..	1	5	..	..	..	1	..	4	2	..	6	10
39	..	1	..	..	..	6	2	1	..	..	..	..	2	1	5	5
40	..	..	1	1	..	3	..	..	..	..	..	2	..	..	4	5
41	..	1	1	..	..	1	..	..	1	..	1	..	..	..	..	2
42	..	..	..	..	..	..	1	..	..	..	..	..	1	2	3	2
43	..	..	1	..	..	..	1	..	..	..	..	1	2	1	3	..
44	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..
45	..	..	2	1	1	..	1	..	..	..	..	..	..	..	..	..
46	..	1	1	..	1	..	..	..	..	..	..	..	..	..	1	..
47	..	..	1	..	1	..	..	..	..	..	..	..	..	..	2	..
48	..	..	..	2	1	..	..	..	..	..	..	..	..	..	..	..
49	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..
50	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
51	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..
52	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
53	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
54	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..
55	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
56	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
Total number	13	9	10	8	8	153	49	12	24	68	24	25	114	25	82	62
Average, length cm.	29.1	35.0	44.5	49.5	45.7	33.7	32.9	29.9	27.1	27.4	31.9	35.4	31.5	33.9	35.9	36.6

Table II, C (continued).

	The Sound																			
Date	12-13/6 1923	14/6 1925	19/6 1925	22/6 1927	22/6 1927	23/6 1920	2/7 1925	3/7 1925	29/7 1929	20/8 1924	23/8 1911	26/9 1925	4/4 1925	3-6/4 1929	7-20/4 1909	26/4 1922	21-30/4 1909	8-10/5 1926	26/5 1908	30/5 1927
Locality	N. of Hven	E. of Taarbæk Reef	N. of Hven	ESE. of Sletten	E. of Taarbæk Reef	N. of Hven	N. of Hven	Køge Bay	N. of Hven	N. of Hven	N. of Hven	The Sound northern part	S. of Fyen	Northern Belt Sea	Langelands-Belt	Nyborg Fjord	Langelands-Belt	South Little Belt	Kerteminde Bay	Kerteminde Bay
Depth, m.	c. 20	13	19-24	15	13	c. 20	28	14	c. 20	c. 30	35	5-27	15-25	3-4	35	6-14	35	20-36	4	12
Fishing-gear	T.	T.	T.	T.	T.	T.	T.	T.	T.	T.	T.	T.	T.	T.	H.	T.	H.	O.	E. S.	T.
cm.																				
18	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4
19	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1	..	4
20	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	1	..	7
21	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	1	..	1	..	18
22	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	1	..	2	..	14
23	..	..	..	..	..	..	..	..	..	..	..	..	2	2	1	2	..	2	2	4
24	..	..	..	2	..	..	..	..	..	..	..	..	1	4	1	2	..	1	6	4
25	..	2	1	2	..	1	1	..	..	..	..	..	..	3	2	3	2	1	2	2
26	..	4	..	1	..	2	2	..	..	..	..	..	1	1	3	2	1	4	2	..
27	..	2	..	3	1	2	1	1	..	..	1	3	1	2	1	2	1	1	2	..
28	..	2	3	2	2	3	2	2	..	..	1	1	..	..	1	6	3	..	3	..
29	4	3	4	6	4	5	1	3	..	..	1	2	3	..	1	..	5	..	1	..
30	2	3	6	2	2	5	5	6	2	..	3	1	1	..	..	1	4	..	..	..
31	2	2	3	3	2	2	4	2	..	..	4	2	1	..	1	..	..	1	..	..
32	6	4	3	4	3	3	3	2	..	..	1	5	..	1	..	..	..	..	..	..
33	3	1	3	4	1	2	6	2	1	1	1	4	..	..	..	..	..	..	..	..
34	2	1	1	..	1	1	5	2	4	1	1	5	..	..	..	..	..	..	..	..
35	2	1	..	..	1	..	7	..	2	..	..	3	..	..	..	..	..	..	..	..
36	1	..	1	1	..	..	1	1	..	3	1	11	..	..	..	..	..	..	..	..
37	1	..	..	1	1	..	1	..	1	1	..	5	..	..	..	..	..	..	..	..
38	..	..	..	..	..	..	1	..	3	1	1	5	..	1	..	..	..	..	..	..
39	1	..	..	..	..	..	..	..	1	2	..	3	..	..	..	..	..	..	..	..
40	..	..	..	..	..	..	..	..	..	1	..	3	..	..	..	..	..	..	..	..
41	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..
42	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..
43	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
44	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..
45	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..
46	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
47	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
48	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
49	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
50	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
51	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
52	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
53	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
54	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
55	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
56	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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60	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total number	24	25	25	31	18	26	40	21	14	14	15	58	12	19	12	20	16	15	18	57
Aver. length cm	32.5	29.4	30.5	29.7	30.9	29.5	32.1	30.8	34.9	38.7	31.4	35.3	26.0	24.7	26.0	25.8	28.3	24.1	25.5	21.3

	Belt Sea																E. of Møen and Falster		Round Bornholm	
4/6 1925	4/6 1925	8/6 1927	11-13/6 1927	16/6 1927	18/6 1927	1-24/6 1909	2/7 1919	9/7 1919	11-12/7 1929	8-16/7 1911	28/7 1928	14/8 1919	21/8 1923	24/8 1923	26t28i/8 1913	1/9 1919	6/10 1927	6/8 1923	27-28/6 1927	23-27/7 1925	24/7-3/8 1907
Lønstrup Vig	Kalø Vig	SE. of Fyen	Nyborg Fjord	N. and E. of Samsø	Kertemiinde Bay	Langelands Belt	Flækøjet	E. of Vresen	South Little Belt	Northern Belt Sea	Southern Belt Sea	Nyborg Fjord	S. of Fyen	Als Sund	Northern Belt Sea	S. of Sprogø	N. by W. of Kyholm	E. of Falster	E. of Møen	Round Bornholm	Round Bornholm
5-9	10-15	14	13	11-33	12	35	c. 8	7-13	6-13	6-30	7-20	8-14	c. 20	c.15-20	10-12	6-30	13	17-23	18-23	36-64	40-90
T.	T.	T.	T.	T.	T.	H.	T.	T.	T.	O.	T.	T.	T.	T.	O.	H.	T.	O.	T.	T.	O.
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..	..	..	4	5	3	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	2
1	..	..	6	8	4	..	..	..	2	1	..	..	..	1	..	..	..	1	..	1	1
1	2	1	2	7	..	2	..	..	1	1	..	..	..	..	..	..	..	1	..	..	2
5	1	2	5	14	2	3	..	..	2	2	..	..	..	1	..	..	..	3	..	1	2
2	2	1	2	13	1	1	..	..	5	1	..	4	..	1	..	..	..	3	..	1	1
4	2	3	..	5	3	2	2	..	2	5	..	3	..	..	..	..	4	..	1	1	2
4	..	4	1	1	..	1	2	1	5	1	..	9	..	2	..	1	4	2	2	..	4
2	2	2	..	1	..	2	1	2	4	5	..	16	..	2	..	2	8	1	1	..	..
2	..	2	..	1	..	..	2	5	3	3	..	11	..	1	..	2	4	2	1	..	1
1	..	..	1	2	..	..	1	6	7	..	..	7	3	1	1	3	4	4	..	..	..
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1	1	..	..	..	..	..	2	5	..	..	4	9	3	..	1	1	2	..	2	..	..
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3	15	20	23	64	20	12	12	37	33	25	18	105	22	11	13	11	29	21	13	5	24
.3	29.9	28.6	24.0	25.2	22.7	25.7	30.7	32.9	28.3	28.8	35.5	31.9	36.6	28.5	36.1	30.8	29.8	27.8	32.6	26.6	23.7

Table II, D. Measurements of Length of III-Group of Cod

O. = Otter Trawl, T. = Tog, H. = Hooks

	North Sea and Skagerak						Kattegat					The Sound									
Date	10-30/4 1907	31/5-2/6 1907	14-27/9 1922	21-22/9 1905	4/10 1905	30/3 1927	20-30/5 1927	7/7 1911	28-29/8 1913	3-4/10 1906	10-28/10 1905	23/6 1920	30/6-1/7 1924	31/7 1924	20/8 1924	23/8 1911	25/9 1924	7-20/4 1909	1-15/5 1909	5/5 1906	8-10/7 1926
Locality	Horns Reef Area	Skagerak	Horns Reef Area	2 miles W. of Thyborøn	Tannis Bay	Horns Reef Area	South Kattegat	SE. of Læsø	Schultz' Grund	Læsø Trindel	North Kattegat	N. of Hven	N. of Hven	E. of Taarbæk Reef	N. of Hven	N. of Hven	N. of Hven	Langelands Belt	Langelands Belt	NE. of Sprogø	Southern Little Belt
Depth, m...	11-40	60-210	30-49	12	15	10-40	10-36	6-8	30	30	20-40	20	c. 30	16-18	30	35	c. 30	35	35	8	20-36
Fishing-gear	O.	O.	O.	O.	O.	O.	T.	O.	D. S.	O.	O.	T.	T.	T.	T.	T.	T.	H.	H.	T.	O.
cm.																					
23	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
26	..	..	..	..	..	..	.	.	.	..	..	..	..	..	..	..	..	..	2	..	..
27	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	3	..	2
29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	2	2	2
30	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	7	1	2
31	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	5	2	4
32	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	4	9	1	2
33	..	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..	4	3	3	..
34	..	..	..	..	..	..	2	1	5	..	..	..	..	2	1	..	..	2	6	1	4
35	..	..	..	..	..	..	..	..	2	..	..	..	..	2	1	..	..	5	2	1	2
36	..	..	..	..	..	..	..	2	4	1	..	1	..	4	1	..	..	2	..	2	5
37	..	..	..	..	..	..	1	1	4	..	..	1	..	2	..	..	..	2	1	2	6
38	..	..	..	..	..	..	2	1	8	..	1	4	2	2	1	..	..	2	1	1	7
39	..	..	..	..	..	..	..	..	7	1	..	2	..	6	1	..	..	..	..	1	5
40	..	..	..	..	..	..	..	..	5	1	..	3	1	7	2	..	..	1	..	..	1
41	..	1	..	..	..	..	..	1	11	..	..	2	1	8	7	1	1	1	..	1	2
42	..	.	..	..	..	..	1	1	6	..	1	2	1	5	5	2	1	1	..	1	2
43	..	..	..	..	..	..	..	..	10	1	1	1	3	7	1	1	2	..	1	..	2
44	..	1	..	..	..	..	..	1	5	..	..	1	..	1	..	3	1	..	..	..	1
45	..	..	..	..	..	..	1	..	4	..	1	2	1	2	2	2	3	..	..	..	1
46	..	..	..	..	..	..	..	..	7	1	1	..	2	1	1	1	3	..	..	..	1
47	1	..	..	..	..	..	..	..	6	..	1	2	1	..	1	..	1	..	..	..	..
48	..	1	1	..	..	..	..	..	1	..	..	..	..	1	1	2	2	..	..	..	..
49	1	1	..	..	..	..	..	..	3	1	2	..	..	1	..	3	3	..	..	..	..
50	1	1	..	..	..	..	..	..	1	1	..	..	..	..	..	2	2	..	..	..	..
51	1	1	..	..	..	..	..	..	1	..	..	..	..	..	1	1	..	..	..	..	..
52	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	3	..	..	..	..	..
53	..	1	..	..	..	..	..	..	1	..	..	1	..	..	..	1	1	..	..	..	..
54	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
55	..	1	..	1	1	..	..	..	..	..	2	..	..	..	..	..	1	..	..	..	..
56	1	..	..	2	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
57	..	..	..	..	1	..	..	..	..	..	..	1	..	..	..	1	..	..	..	..	..
58	1	..	..	..	..	1	..	..	..	..	..	1	..	..	..	1	..	..	..	..	..
59	..	..	1	2	..	..	..	..	..	..	..	1	..	..	..	1	..	..	..	..	..
60	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61	..	..	1	..	1	1	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
62	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
63	..	..	..	1	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
64	1	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
65	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
66	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
67	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
68	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
69	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
70	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
71	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total number	9	8	5	8	5	5	7	8	95	7	11	26	12	53	26	25	21	35	42	19	51
Aver. length, cm.	57.0	48.9	59.6	59.6	61.6	64.6	37.6	37.5	40.9	42.3	47.5	43.2	41.7	39.1	40.7	47.5	45.9	32.5	30.9	33.5	35.4

t different Localities in the Waters round Denmark.

.S. = Danish Seine.

	Belt Sea														True Baltic E. of Falster				True Baltic Round Bornholm			
	31/5	20-23/5	10-31/5	11/6	12-13/6	1-24/6	16/6	8-16/7	18/7	28/7	12/8	20/8	24/8	25/8	8-11/5	7-13/5	6/6	13/8	c. 20/6	24/7-3/8	20-27/8	c. 1/9
	.928	1928	1909	1928	1928	1909	1927	1911	1924	1928	1928	1913	1923	1924	1926	1928	1923	1928	1923	1907	1928	1927
	Northern Belt Sea	Northern Belt Sea	Langelands Belt	Southern Belt Sea	Southern Belt Sea	Langelands Belt	Northern Belt Sea	Northern Belt Sea	Kalø Vig	Southern Belt Sea	Smaalands-havet	SE. of Sprogø	Als Sund	N. of Avernakø	Western Baltic	Hjelms Bay	E. of Falster	Hjelms Bay	Round Bornholm	Round Bornholm	Round Bornholm	S. and E. of Bornholm
	2-20	20-58	35	9-20	20-40	35	11-33	6-30	9-12	9-20	5-15	27-45	15-20	c. 14	23-27	7-23	17-23	7-23	40-60	40-90	31-78	35-90
	T.	T.	H.	T.	T.	H.	T.	O.	T.	T.	T.	T.	T.	T.	O.	T.	O.	T.	O.	O.	T.	T.
	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..
	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..
	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	3	..	1	7	..	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..
	..	1	3	..	2	3	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..
	..	2	5	..	1	6	1	2	..	..	..	..	..	..	..	..	..	..	..	1	..	..
	1	..	11	1	6	15	..	2	1	..	..	1	..	..	..	..	..	..	..	..	..	..
	1	1	10	2	7	8	1	3	..	..	..	..	1	..	..	..	..	..	..	1	..	..
	..	3	6	..	10	3	2	1	..	..	..	..	..	..	..	..	..	..	..	..	1	1
	1	2	4	1	13	2	1	1	..	..	..	1	1	1	2	..	1	1	2	..	1	..
	3	6	1	3	8	3	2	1	1	2	..	..	2	..	1	..	..	..	1	..	..	..
	1	4	..	2	10	3	2	1	..	2	..	..	1	1	2	1	1	1	2	..	6	2
	2	2	4	6	8	5	..	..	1	5	..	..	2	2	1	..	1	1	1	..	..	2
	..	7	..	4	4	2	2	2	..	7	..	1	2	1	2	1	2	3	2	..	..	..
	2	8	..	2	5	2	1	2	3	6	5	1	2	1	1	1	1	1	1	..	2	1
	2	4	..	7	3	..	..	1	3	9	5	..	..	1	..	..	2	1	..	..	1	1
	..	3	..	8	3	..	1	..	3	7	8	1	..	..	1	2	..	1	1	..	1	..
	3	2	..	4	..	1	..	..	1	8	6	1	..	..	..	2	..	3	..	..	..	..
	2	2	..	3	1	..	..	..	1	10	6	..	..	2	..	..	..	1	..	..	..	..
	5	3	..	2	..	..	..	..	2	8	8	..	..	..	..	..	..	..	..	..	..	..
	3	1	..	2	..	..	..	..	1	8	7	1	1	..	1	..	..	..	1	..	..	..
	1	..	..	3	1	..	..	..	..	5	6	1	..	..	..	..	..	..	..	..	..	..
	1	..	..	1	..	2	..	..	..	4	3	1	..	1	..	..	1	..	..	..	..	..
	1	..	..	..	1	..	..	..	1	5	2	2	..	1	..	..	..	..	..	..	..	..
	1	..	..	..	1	..	..	..	..	3	..	1	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	2	3	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	2	1	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	..	..	..	..	..	..	..

Table II, E. Measurements of Length of IV-Group of Cod at different Localities in the Waters round Denmark.

O. = Otter Trawl, T. = Tog, D.S. = Danish Seine, H. = Hooks.

	North Sea a. Skagerak		Kattegat					Belt Sea											True Baltic Round Bornholm		
Date	30/4 1907	21-22/9 1905	4-5/5 1927	20-30/5 1927	31/7 1929	11-16/8 1929	28/8 1913	7-20/4 1909	21-30/4 1909	1-15/5 1909	9/5 1927	16-31/5 1909	29/5 1908	1-24/6 1909	16/6 1927	6/9 1913	27/9 1929	6/10 1927	27-28/4 1927	21-22/4 1925	7-22/6 1923	30/8 1927
Locality ...	Horns Reef Area	2 miles W. of Thyborøn	W.-Kattegat	South Kattegat	S. and W. Kattegat	S. and W. Kattegat	Schultz' Grund	Langelands Belt	Langelands-Belt	Langelands Belt	Maarup Vig	Langelands Belt	SE. of Sprogo	Langelands Belt	Northern Belt Sea	SE. of Sprogo	E. of Samsø	E. of Samsø	E. of Moen	At Christiansø	Round Bornholm	E. of Adler Grund
Depth, m...	11-48	12	5-19	10-36	10-30	10-30	30	35	35	35	c. 12	35	c. 40	35	20-50	c. 40	20	12	18-23	c. 90	40-90	c. 40
Fishing-gear	O.	O.	T.	T.	T.	T.	D. S.	H.	H.	H.	T.	H.	H.	H.	T.	T.	T.	T.	T.	T.	O.	T.
cm.																						
31	..	..	..	..	..	..	..	..	..	..	..	2	..	1	..	.	.	..	..	..	..	..
32	..	..	..	..	..	..	..	1	..	2	..	3	..	5	..	..	..	..	..	..	..	1
33	..	..	..	..	..	..	..	1	1	2	..	1	1	1	..	..	..	..	..	..	..	..
34	..	..	..	..	..	..	..	2	..	2	1	7	..	5	..	..	..	..	..	..	..	..
35	..	..	..	.	..	..	..	..	1	2	..	5	..	4	1	..	..	..	..	1	..	..
36	..	..	..	..	..	..	..	3	2	3	1	6	..	2	1	..	..	..	..	..	1	..
37	..	..	1	..	..	..	1	2	..	2	..	4	1	3	..	..	..	..	..	..	..	1
38	..	..	..	1	..	..	3	1	..	..	1	3	..	2	1	..	..	..	1	..	1	..
39	..	..	..	..	..	..	3	..	..	..	..	2	..	1	..	..	1	..	..	1	..	..
40	..	..	1	..	..	..	2	1	..	..	1	..	2	2	1	..	..	1	..	4	1	..
41	..	..	..	1	..	..	7	1	..	..	..	..	1	..	1	1	..	..	..	..	..	1
42	..	..	1	..	..	..	6	..	1	..	..	2	1	1	1	..	..	..	1	1	..	2
43	..	..	1	..	..	..	5	1	..	1	2	..	1	..	1	..	1	..	1	1	3	..
44	..	..	1	1	..	..	9	..	..	..	1	1	..	..	1	..	..	1	3	1	1	..
45	..	..	1	1	..	..	6	1	..	..	..	..	..	1	1	..	..	1	..	1	..	..
46	..	..	..	..	..	..	8	..	1	..	..	..	..	1	..	..	2	..	1	1	..	1
47	..	..	..	1	..	..	6	..	..	..	..	..	..	1	..	..	1	1	..	..	..	1
48	..	..	..	..	..	..	9	3	..	..	..	..	1	..	2	1	2	..	..	..	..	..
49	..	..	1	..	..	..	12	1	1	..	..	..	2	..	1	1	..	1	2	..	..	..
50	..	..	..	..	..	1	5	..	..	..	..	..	1	..	1	1	1	2	1	1	..	..
51	1	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
52	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	1	..	..	1	..	1	..
53	..	..	1	..	1	2	4	..	1	..	..	..	..	..	..	1	..	..	1	..	..	..
54	..	..	..	..	..	..	4	..	..	1	..	..	..	..	..	1	..	1	1	..	..	..
55	..	..	..	..	1	..	2	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
56	..	..	.	..	..	1	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
57	..	..	..	..	..	..	2	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..
58	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
60	..	..	..	..	1	..	3	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..
61	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..
63	..	..	..	..	1	1	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
64	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
65	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
66	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
67	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
:	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
75	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
76	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total number	4	2	8	6	5	6	114	18	8	15	7	36	13	30	15	10	8	9	14	12	9	7
Aver. length cm.	66.5	64.5	44.1	44.5	58.0	55.7	47.5	39.7	41.3	36.3	39.7	35.8	46.2	36.4	45.2	51.9	45.9	47.8	47.7	42.0	44.2	41.0

Table II, F. Measurements of Length of V-Group of Cod at different Localities in the Waters round Denmark.

D. S = Danish Seine, H. = Hooks, O. = Otter Trawl.

	Kattegat	Belt Sea			True Baltic
Date	28-29/8 1913	9-20/4 1909	29/5 1908	20/8-6/9 1913	7-22/6 1923
Locality	Schultz' Grund	Langelands-Belt	SE of Sprogø	SE of Sprogø	Rouod Bornholm
Depth, m.	30	35	c. 40	c. 40	10-90
Fishing-gear	D. S.	H.	H.	H.	O.
cm.					
38	..	1	..	..	..
39	1	..	..	..	..
40	2	1	..	..	..
41	1	..	..	..	1
42	4	2	..	..	..
43	6	..	..	..	..
44	4	..	..	..	..
45	7	..	..	..	..
46	4	..	1	1	..
47	7	..	1	..	..
48	1	..	1	1	..
49	10	..	..	..	1
50	6	..	2	3	..
51	11	1	..	1	..
52	6	..	..	..	1
53	7	..	..	..	..
54	11	..	..	1	..
55	7	..	..	..	..
56	9	..	..	..	..
57	1	..	1	..	1
58	14	..	..	1	..
59	6	..	1	..	..
60	4	..	..	..	..
61	2	..	..	1	1
62	3	..	..	..	..
63	6	..	..	..	..
64	2	..	..	..	..
65	2	..	..	..	..
66	4	..	..	..	..
67	1	..	..	..	..
68	4	..	..	..	..
69	1	..	..	..	..
70	..	..	..	..	..
71	4	..	..	..	..
72	1	..	1	..	..
73	..	..	..	1	..
74	..	..	..	..	..
75	1	..	..	..	..
Total number	160	5	8	10	5
Average length, cm.	54.2	12.6	53.6	54.1	52.0

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Postscript.

After the present paper had been committed to print a paper has been published by JOHS. SCHMIDT[1]) in which the racial question of the Atlantic Cod is studied. Also the cod in the Danish waters with the Baltic has been dealt with in this comprehensive and interesting investigation. The mean numbers of fin rays in the second dorsal fin and of the vertebrae found by JOHS. SCHMIDT correspond in the main very well with those stated in the present paper (Section III and IV). In some few cases there is between the numerical values stated by Prof. SCHMIDT and by me for cod caught in almost the same area a somewhat greater difference than can be explained from a deficiancy of the material to hand. The reason of these differences can surely be found in the fact that the cod in the waters between the Skaw and Bornholm undertake comprehensive migrations, and thus the racial numerical values of the cod in a given locality need not always to be the same. In this connection it must also be taken in consideration, that the numerical values in our inner waters are not the same for the different age groups (see p. 20). As JOHS. SCHMIDT in most cases has not stated the age group or year class of the cod investigated it has not been possible to see, whether the difference found between the numerical values of cod from almost the same locality are not due to the fact that different year classes have been studied by the two investigations.

Concerning the cod of the Baltic proper JOHS. SCHMIDT has substantiated the interesting fact that the numbers of fin rays in D 2 decrease when we from the Bornholm waters move to the east and north in the Baltic whilst the numbers of vertebrae increase.

JOHS. SCHMIDT concludes from this "that the eastern Baltic has an indigenous cod population which is independent of the waters outside". That an indigenous cod stock occurs in the Baltic proper is undoubted (p. 20), thus the investigations mentioned in the present paper show that cod eggs and cod larvae occur in numbers in the waters east of Bornholm, where also quantities of spawning cod have been fished. It is however proved in the present paper that the cod population, at any rate in the waters round Bornholm, is not independent of the waters from the Skagerak to the Western Baltic. The racial analyses stated on p. 20 show that in the Bornholm waters the numbers of rays in the D 2 increase from the younger to the older age groups, which undoubtedly must be caused by an immigration of cod from the Belt Sea and the Kattegat.

[1] JOHS. SCHMIDT: Racial Investigations X. The Atlantic Cod (*Gadus callarias* L.) and Local Races of the Same. Comptes-Rendus des Travaux du Laboratoire Carlsberg. 18. Vol. No. 6. 1930.

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» 9 A. C. Johansen og J. Chr. Løfting: Om Fiskebestanden og Fiskeriet i Gudenaaens nedre Løb og Randers Fjord. — With an English Resumé. 4 Tavler. 42 Textfigurer. 1919. 169 Sider. Kr. 3.75.
» 10 Erik M. Poulsen: Om Hummeren og Hummerfiskeriet i de danske Farvande. 6 Textfigurer. 1927. 42 Sider. Kr. 1.00.

The name: »Kommissionen for Havundersøgelser« has from the 1st of September 1926 been changed to: »Kommissionen for Danmarks Fiskeri- og Havundersøgelser«.